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and
The AIRCRAFT ENGINEER

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Editor
C. M. POULSEN

Managing Editor
G. GEOFFREY SMITH

Chief Photographer
JOHN YOXALL

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The Outlook

Mobility of Air Power

IN his series of interesting articles Capt. Macmillan has several times pleaded for the formation of a Blockade Command in the Royal Air Force, so as to ensure that attacks on German production should not be interrupted by diversion of bombers to other objectives. In his article this week he complains that British attacks on German production seem to have been less heavy of late, presumably because (so he reads the situation) some squadrons have been sent away to help in the fighting in the Mediterranean and Egypt, and he considers that wrong policy.

This subject is dealt with very fully in the book, *Air Power and Armies*, by Wing Commander (as he then was) J. C. Slessor, and particularly on the pages 70 to 80. The author of the book is now an Air Commodore, and at the outbreak of war was Director of Plans at the Air Ministry, so his opinion deserves to be treated with respect. We cannot quote extensively from the book, but may summarise the distinguished writer's views by saying that he constantly pleads for the "mobility" of bombers, and is strongly opposed to tying up a certain number of them permanently to any one class of work. On page 60 he writes: "Thus fighting troops are the primary objective during actual battle periods, whether in attack or defence. Attack on production assumes the first importance during what the Field Service Regulations describe as 'periods of inactivity' on the ground. And midway between the two, supply in the field will probably be the most suitable objective during periods of preparation for battle on the ground . . ."

So, if it is true that a force of bombers has been diverted from the attack on German production to take part in the active operations in the Mediterranean, authority can be quoted for such action; in fact, it was what was to be expected from the office of the Director of Plans.

German Night Bombing

WHATEVER the spring may bring forth—and Lord Beaverbrook believes that Hitler will try an invasion of Britain in the spring—for the moment the Germans seem to have laid aside the idea of day bombing of this country. It is not really surprising that they should do so, for they met with a heavy and expensive defeat in the late summer and autumn; but it is gratifying to see our very self-assured enemy giving up one of his pet war theories. His present policy gives the impression that he has also abandoned the idea of forcing Britain to surrender by frightfulness, if he ever believed in that possibility, which is more than doubtful. He still likes to kill Britons and wreck their homes when that can be done without too heavy a loss of German aircraft, but that is a normal manifestation of the brute beast in the modern Hun. The present tactics of the *Luftwaffe* are night raids against industrial cities, taking one after another in turn, and paying repeated visits to each.

It was known to be a German theory before the war that night bombing could not be sufficiently accurate to give useful military results, and so the present behaviour of the enemy shows another confession of wrong calculations. The smaller cities, though many of them are large enough when not compared with London, naturally make slightly more promising targets. There must be a greater chance of the bomb dropped at random hitting something of military importance. Still, however, the night flying of the Germans is not highly skilful, and the bombers keep to a height which makes their aim speculative, despite the flares and the fire-bombs. These tactics are not those of a combatant sure of victory, but rather of a puzzled player who does not know what is the wisest thing to do next. And all the time war production goes on across the Atlantic where the *Luftwaffe* cannot reach it.

Crikey!

THE Minister for Aircraft Production let the cat out of the bag in his broadcast talk on December 17 when he referred to the good work done in establishing air supremacy in the daytime by our "fighter squadrons of Hurricanes, Spitfires, Defiants and Whirlwinds." We shall probably never know whether Lord Beaverbrook did this deliberately or whether his close association with the production of the new and "secret" types of aircraft made him momentarily forget the existence of a secret list.

We prefer to think that Lord Beaverbrook takes the same view as *Flight*, that when the name has been given in an American journal, and a good deal more than the name, it is rather silly to maintain the silence which has been forced upon, and loyally observed by, every British journal and newspaper in the country. We drew attention to this anomalous state of things in our issue of December 12, and since then an American correspondent in London has expressed to her newspaper in Chicago dissatisfaction with the reflection which must necessarily be cast on all American correspondents in this country by the untimely publication in America of the article in question.

The *Daily Telegraph* has also taken the matter up and supported *Flight* in its exposure. As we are about to go to press, a question is being put in Parliament; we await results with interest.

We do not propose to assist the enemy by stating whether we consider the information published in the American journal reliable or otherwise. But we feel that *Flight* readers are entitled to know that the Whirlwind is a Westland fighter of somewhat unorthodox design. In the early days of its existence the local inhabitants of Yeovil came to nickname it the "Crikey!" as they could not well avoid noticing its great speed when Mr. Penrose was out on test flights. At that time the famous Shell advertisement was a familiar sight, and the Whirlwind did cause a rapid swing of the head of the onlooker as it flashed past.

In addition to mentioning the name of the new fighter, Lord Beaverbrook also inferred, by grouping it with the three older types, that it has already seen active service and done good work.

"Those 3,000 a Month"

DURING his talk the Minister for Aircraft Production also paid a tribute to the workers in British aircraft factories who had, by their courage and disregard for air-raid danger, not only maintained but increased the weekly rate of production during November and December. The output in four months had been double that of last year. The output from America was increasing, and in 1942 it would reach "the famous 3,000 a month."

That, of course, is comforting—if it materialises. But one is getting rather tired of all these astronomical numbers which roll so glibly off the tongues of politicians. In fairness to the American aircraft constructors, it should be said here that *they* have never drawn the long bow to that extent. On the contrary, they have been almost unanimous in their efforts to get the politicians to take a realistic view of production problems; 1,000 aeroplanes, let alone 10,000 aeroplanes, are not produced by merely placing the order. That is the easiest part of the transaction. If the materials are available the workers will not, we feel sure, fail to do their part in turning those materials into first-class aircraft and engines.

BROUGHT TO BUQ-BUQ: Hurricanes have given of their very best in the battle for the Libyan frontier. With their Gladiator stable-mates they have established air ascendancy over the *Regia Aeronautica*.

WAR in the AIR

The Victory in Libya : Brave Work in Albania : The Air War in the North

VALONA VALEDICTION : An assortment of British bombs laid out on a Greek aerodrome awaiting transport to Albanian ports.

ALL the countries bordering the Mediterranean and all that make up the Near and the Middle East have been shaken to the core by the great British victory of Sidi Barrani. The British Army on the offensive was a new thing in this war, and all the Mediterranean peoples knew how the Army of the Nile was outnumbered by the great force under Marshal Graziani since the defection of the French troops in Tunisia, Algeria and Syria. What they did not know was the extent of the reinforcements sent out to Egypt from Great Britain as well as from India and the Dominions on the other side of the world. Command of the seas permits surprises of this nature to be sprung on a too confident opponent. Though he was known as a cruel Governor, the Italian Marshal had the reputation of being a good soldier, but he made the mistake of despising his enemy. Consequently, his reputation has now fallen grievously, while that of Sir Archibald Wavell stands very high. One would much like to know how General Weygand feels about it all, for not so many months ago he was commanding the French forces in Syria, and General Wavell was working as his close associate.

After the first dash, the rate of the British advance was bound to slow up. The victorious troops had had an extremely trying time in the desert, apart from hard fighting in places, for some Italian divisions made a stout resistance. A sand storm worked up, and that would add much to the trials of both victors and vanquished. In an old-time battle, now would have been the time to push on the cavalry in pursuit, though horses need water in even larger quantities than men need it. The modern cavalry regiments are mechanised, and doubtless they are hurrying on the heels of the Italians with throttles open. Here one feels tempted to bring Macaulay up to date:

"But under those fierce aircraft still thicker lay the slain;
"And after those swift Blenheims the Lancers toiled in vain."

Good Air Work

THE R.A.F. and Fleet Air Arm have manfully converted themselves into the air arm of the Army. They bombed all the Italian bases before the assault, they helped the troops by low flying attacks, and they pursued the defeated enemy. The single coast road is as bad a line of retreat as the mountain gorges in Palestine and Bulgaria were to Turkish and Bulgarian Armies in 1918. There is no escape from it. The Royal Navy also plays its part, shelling the roads at suitable points and smashing up ships in the ports. One only wishes that there were ten times the number of aircraft which there are in the Middle East Command, but it has been a great help to get the contingents from South Africa Rhodesia and Australia, all of which arrived without having to be escorted through the Mediterranean sea.

Bardia is the most easterly of the important Italian ports in Libya, and, as one of the R.A.F. contributions to the success of General Wavell's movement, it was very heavily bombed by the R.A.F. on December 16 both by daylight and during the following night. The Italians made every effort to defend it, but the R.A.F. bombers pressed home their attack with the greatest determination and reduced the port to an absolute inferno.

British Air Mastery

IN addition to this, Italian aerodromes all along the coast were so successfully raided that large numbers of enemy aircraft were either destroyed or made unserviceable, and many of them have fallen into the hands of the British troops as they advanced. Consequently, the troops were not very much harried from the air as they moved, and for this they owe a big debt of gratitude to the R.A.F. British mastery of the air in Libya is very definite.

In the course of this fighting, one Flying Officer shot down six Italian machines in a quarter of an hour. They were all Fiat CR 42 fighters, but proved no match for one Hurricane flown by an expert pilot who had won the D.F.C. in Palestine. Five of the Italians jumped with their parachutes. During the fight the Glycol tank of the Hurricane was pierced, and the pilot had to open his hood and keep his head outside, hoping that his machine would not catch fire. He flew blind through the smoke and fumes for three or four minutes, and finally contrived to land his machine behind the British troops in a cross wind.

Whereas in Egypt the winter is the best time for campaigning, for only the nights are cold, the troops and squadrons in Greece have been suffering much from the season. The mountains over which the aircraft have to fly through storm, snow and cloud, are a perfect night-

WAR IN THE AIR (CONTINUED)

mare to the pilots, but we hear of few losses. It is not the custom to publish news of machines lost in accidents, only those lost through enemy action, but in some cases the expression "failed to return" leaves one in doubt as to whether the Fiats or the mountain storms were responsible. Despite everything, the R.A.F. squadrons in Greece keep flying and keep on damaging the Italian forces. The *Regia Aeronautica* has not been so much in evidence of late, for which the Greek troops are very grateful. It, too, has been suffering from the weather, and, moreover, its aerodromes have been frequently and heavily bombed by the R.A.F. and the Greek machines.

How the Bridge was Broken

IN a previous issue we told how bombing of a bridge on the road behind Koritza had helped the Greeks to take the town. It will be remembered that the attack was made by three Blenheims, of which only one came back. Here is the account given by the members of the surviving crew.

The story is told by the sergeant pilot, air observer and air gunner of that aircraft: "We were over Lake Okhrida at about 6,000 feet and above the clouds," said the pilot. "We could see nothing below, so the Flight Commander ordered us to dive. We were astern of him and 350 m.p.h. showed on the clock. The other sergeant pilot peeled off and we never saw him again. We got down into the valley and spotted a lot of transport and troops on the road that wound through the valley. The Flight Commander dropped bombs on the lorries and troops, and we machine-gunned them at the same time, doing a lot of damage. The ground fire was pretty intense, but it didn't get us anywhere vital. I lost sight of the Flight Commander but saw a stone bridge, a three- or four-arch affair, over a ravine, with a convoy crossing it. We let go at it, got a direct hit, and bits of our own bombs came back and hit us. We still had some bombs left and went on down the valley towards Koritza, but there were no troops beyond the bridge. It looked as if we had blocked the road at just about the right time. Then fighters came after us, and we nipped into a cloud and came home."

The observer told the same story, except he had more time to watch the effect of the large calibre bomb that struck the bridge: "I saw the bomb explode at one end of the bridge and the whole thing collapsed in a great cloud of stones and dust and fell into the ravine below."

The rear gunner added: "When I saw the ravine, the bridge no longer existed. I could see where it had been. Nothing could get across that ravine. Earlier on I had seen a house go up, a bomb smack in the centre. I think it was the Flight Commander's. I also saw his hits on the centre of the convoy, and he certainly wrecked it. You could see lorries all over the place and chaps running like mad."

Six days later Greek troops marched into Koritza, a turning point in the campaign.

Valona has been heavily bombed by the R.A.F. on a number of occasions lately. On December 17 the bombers made a night attack on Durazzo, the other main Italian seaport in Albania. The communiqué issued at Cairo gives this account of the incident:—

"In Southern Albania, among other operations carried out by our aircraft, was a heavy raid on Durazzo. This successful night attack was made despite most unfavourable weather. Bombs were seen to cause large explosions in the dock areas. One large and other smaller fires were observed by our aircraft on leaving the target. Our aircraft returned safely."

Naples was raided once more by the R.A.F. on December 14, and, curiously enough, the Italians were the first to mention the raid in an official communiqué. It seems that a number of Italian warships had taken refuge in the harbour there, and bombs burst beside two of them. The Italians stated that "an Italian naval unit of medium tonnage was struck in the port. Damage is not serious, but some 50 were killed and wounded among the crew. A small sailing ship in the harbour was sunk." Making due allowances for the regular Italian way of minimising damage, it may be gathered from this admission that the British bombs were more successful than had actually been hoped. The Italian Navy must be hard put to it to find a spot in which its ships will be really safe.

Sometimes the bomber crews get back to their stations after queer adventures. One crew reported "Missing, Feared Killed," made its way back to its base in Greece after an unusual journey. The squadron raided one of the Albanian ports and two of the aircraft were hit by anti-aircraft shells. One, badly damaged, had great difficulty in making its way back to base. The pilot reported that his companion had also been hit, one engine being seen to stop and that it was likely the aircraft had crashed into the sea. Nothing more was heard for two days, and the crew and aircraft were officially posted as missing. Then three weary men, a pilot, observer and air gunner, arrived at the officers' mess of their station in Greece. Here is the Squadron Leader's description of their adventures:—

"Just as we had released our bombs we received direct hits from anti-aircraft shells. One tore a large hole in the port engine cowling, but it continued to function despite the fact that oil was pouring out. The other engine was hit and stopped almost immediately. The aircraft was holed in many places and there was one enormous rent right through one wing, but the aircraft would still fly, though the force of the explosion had

JUST GREEK TO THEM: A British pilot on the Albanian front tells the Greek ground staff how the battle goes.

WAR IN THE AIR (CONTINUED)

BATTLE PATIENCE : Pilots of No. 74 Fighter Squadron ready for immediate action. The two at the table play battle patience, the one furthest from the camera amuses himself by taking a Browning gun to pieces, while he in the middle distance has "Water on the Brain" to read. It is this squadron which has over 600 enemy machines to its credit.

thrown it on its back. Not one of us was injured, though the note-book in our air gunner's pocket was torn in half by a piece of shrapnel. We flew on slowly, unable to make height on our one engine. The cockpit was full of petrol fumes, and I feared we should pass out. We were a sitting bird all right, but no one came after us. We flew for nearly two hours and then spotted a tiny island. We found only one place to attempt a landing—a strip of beach about twenty yards wide. I gave the chance of jumping to the crew, but they preferred to stand by me. Well, we put the aircraft down safely, although the wheels would not come down, and we made a belly landing.

"There were more difficulties with which to contend. The observer went forward to some peasants, who immediately rushed away screaming. We put our hands up and yelled 'Inglese! Inglese!' A look of wonderment spread over one man's face and he replied with a definite American accent, 'Are youse guys English?' Locals came to the number of about a thousand and looked extremely dangerous, only being kept back by our Americanised friend. At last we persuaded the villagers of this tiny island that we were friendly, and they found us their only car. It didn't last long; it was destroyed soon after by a bomb, one of many that fell that day on this entirely defenceless island. We were bombed eight times in a single day, the only casualties being civilians. Later, we persuaded the owner of a fishing boat to take us to the mainland. We set off at night, going to sleep on the deck, but cold and hungry. Rough waves continually swept the deck. After twenty hours at sea the weather was so rough that the skipper was forced to put into a near-by port, fortunately on the mainland. Here we had a grand reception. All of us were carried shoulder high round the village, being kissed by men, women and children alike. Bouquets showered on us, we were given bottles of local wine, and finally led by the Mayor and Corporation to the town hall.

"I had to make a speech, but as it was in English I do not imagine much of it got over. The most popular part was when I said 'Mussolini' in grim tones and made a sign. That fairly brought the house down. A car was found for us and amid wild cheers and enthusiasm and loaded with gifts we set off across the mountain trail. After a long journey we came to another town, where we were again treated like conquering heroes. Eventually, after walking, travelling by car and by train, we got back here. My crew and I are agreed we wouldn't have missed this grand tour of Greece for anything. It has made us feel that war in this part of the world is really worth while, and we are instilled with renewed enthusiasm."

A Problem

IT is known that the new Army Co-operation Command intends to put into service a bomber which will be specially useful for helping the ground troops of the Army to overcome opposition, in much the same way as the Ju 87 dive-bomber helped the German mechanised divisions. It is a pity that this class of machine is not now available for use in Egypt and Albania. The whole question of attacking personnel from the air needs examination. The artillery has solved the problem on the ground—H.E. for *materiel*, shrapnel for personnel. The A.C. Command of the R.A.F. is doubtless studying it. Machine gun fire is not the most effective way of destroying personnel from up above. The aircraft can only deliver plunging fire, which is not so effective as grazing fire. Numbers of small bombs would seem much better weapons when enemy troops are caught on a road. The aircraft in Egypt and Albania are doing the best with the weapons they have, and we have no doubt that they are doing well.

What Will Hitler Do?

THERE has been speculation as to whether Hitler would go to the help of Mussolini now that the latter has got himself into very deep water, and, if so, how and when. At the moment of writing, there seems to be no sure sign of a German intention to do anything of the sort, though rumours have gone round of the massing of German forces somewhere to the north of the Brenner Pass. On the other hand, it has been reported that Hitler has said that the war must be won by Germany in Great Britain; and Lord Beaverbrook, in a broadcast on December 17, said that we were over-confident, and that Hitler intended to make an attempt to invade these islands in the spring. The Minister of Aircraft Production must have authority for statements which he makes, for the information which reaches the War Cabinet is available to him. Certainly the concentrated attack by U-boats and long-range aircraft on the shipping off the western approaches to Great Britain is causing anxious thought to the Cabinet. To meet it, one measure has been the expansion of the Coastal Command and an increase in its striking power. Doubtless other measures are being taken as well. Bombers of the R.A.F. continue to raid Lorient and Bordeaux at frequent intervals, and they certainly light huge fires in those bases. It is to be hoped that their bombs also destroy submarines and Condor bombers. The so-called invasion ports also receive periodic attention, and the quays, jetties, and other facilities in them must by now be very far from what one would describe as first-rate condition.

Germany proper is not neglected, despite the numerous other calls on the activities of the Bomber and Coastal Commands. Of late there have been series of attacks on Cologne and Dusseldorf. Mannheim has since then been selected for concentrated attacks, night after night. It is the chief industrial centre of the Upper Rhine. On the night of December 16 it was subjected to an especially heavy raid, which lasted for seven hours. In one suburb an aniline dye factory, one of the largest in Germany, was set well alight, and an aircraft factory at Speyer, a town to the south, was also hit. The raid lasted until 3.30 a.m.

Inland ports along the rivers and canals of Germany have been favourite targets in recent weeks, and as the railway

WAR IN THE AIR (CONTINUED)

AIR LOSSES TO DECEMBER 18.

	GERMAN Aircraft	BRITISH Fighter Aircraft	BRITISH Pilots
Dec. 8	3	—	—
" 9	1	—	—
" 10	1	—	—
" 11	2	—	—
" 12	6	—	—
" 13-16	—	—	—
" 17	1	—	—
" 18	1	—	—
	15	0	0

British Bombers lost over enemy territory: Dec. 8, 2; Dec. 9, 1; Dec. 10, 2; Dec. 11, 1; Dec. 12, 2: Dec. 15, 3: Dec. 16, 4. Total, 15.
The Germans have lost 2,737 aircraft from the outbreak of war up to and including Dec. 18. They have destroyed 1,707 British machines.
In the Middle East up to and including Dec. 18, the Italians have lost 353 aircraft (including 15 captured on the ground), and the British have lost 67.
Grand total:—German and Italian aircraft lost, 3,090;
British aircraft lost, 1,774.
These figures do not include enemy machines destroyed by the Royal Navy, the Merchant Navy, or by our Allies.

system of the country has been much disorganised already, it becomes important to interfere with the waterways.

Berlin is visited every now and again. Most of the targets there have been railway stations, though factories are also included in our bombers' attentions. A German communiqué admitted that in a raid on the night of December 15 a part of the underground railway was put out of action for a time. That (if correct) is damage of a "nuisance value," which is not likely to shorten the duration of the war, but will certainly bring home to the population of the enemy capital that war against Britain is not a simple matter of cheering after German victories. It will probably create a distaste in the minds of important sections of the German people for the idea of entering upon a third war with Britain, if the British are once again so kind-hearted as to lose the peace after they have won the war.

As for the efforts of the *Luftwaffe* against Great Britain, up to the moment of writing (it is now always necessary to include that proviso when making a general statement) day raiding has ceased to be a matter of any importance. The Germans seldom make a serious attempt to do any real damage by daylight, though occasional machines make lone-hand raids and drop a few bombs on towns which they find can be attacked without risk to themsleves. When they think it is safe to do so, the pilots come low and try to kill people in the streets with machine-gun fire. This particularly brutal and useless action could hardly have occurred to the mind of any nation but the Germans—though on some occasions the Italians have copied their senior partners. On December 16 a German aeroplane made a machine-gun attack on a passenger train near an East Anglian town. The train stopped, and the driver, fireman and some of the passengers jumped out and lay down in a ditch. The pilot came down to less than 100 feet, according to accounts, and made nine runs over the train. The fireman received a glancing blow from a bullet on his head and was taken to hospital. No one else was hurt.

Casualties

BY night the German bombers are also adopting the tactics of concentrating on one town for several nights in succession. The latest place to be selected has been Sheffield. A certain amount of damage was done there, and people were killed and wounded. London had a number of quiet nights with no raiders, or very few, overhead.

During the month of November 4,588 civilians were killed in air raids in this country, and 6,202 wounded cases were detained in hospital. The number of deaths in a month has declined slightly but steadily since the peak period in September.

Sir Archibald Sinclair, the Secretary of State for Air, has sent the following message to Air Chief Marshal Sir Arthur Longmore, Air Officer Commanding-in-Chief, Middle East R.A.F. Command: "The War Cabinet has instructed me to convey their admiration to officers and men of all ranks in the R.A.F., Middle East, for the indispensable part they are playing in the victorious operations in the Western Desert. Their work in conjunction with the Army and Navy has been a pattern of effective co-operation between the Services, and the determination with which their attacks have been pressed home and the magnificent success they have achieved against a numerically superior enemy have added a fresh page to the glorious record of the R.A.F."

Air Chief Marshal Sir Arthur Longmore has replied: "Please express to the War Cabinet the thanks of the R.A.F., Middle East, for their encouraging message, which is greatly appreciated by all ranks. We are proud to be contributing to the victorious operations in the western desert, and both officers and men are in grand form."

A Gift from the East

THE Lord Mayor of London, Sir George Wilkinson, has received from General Sir Archibald Wavell and Air Chief Marshal Sir Arthur Longmore £17,000 for the victims of German air raids in this country. This sum, it was stated in a telegram to the Lord Mayor, had been contributed by all ranks of the Army and the Royal Air Force and by the Allied contingents fighting in Egypt, Palestine and Transjordan, Sudan, East Africa and Aden, "as an expression of the pride and admiration with which we view the courage and tenacity of the civilian population in the United Kingdom." The message added: "It is hoped that this contribution will help to convey to the relatives and friends from whom we are separated not only our sympathy towards those who have suffered but also our unshakable determination to share with them in all hardship and endeavour until our common cause has triumphed."

The Lord Mayor, in his acknowledgment, referred to "the delight with which the citizens of London have heard of the brilliant victories which have been won during the past few days, the result of wonderful organisation and of the courage and endurance of your men. We wish you continued success."

Mr. Churchill on the War

THE Prime Minister reviewed the situation in the House of Commons on December 19. Speaking of home defence, he made the following remarks: "We are not afraid of any blow which may be struck against us, but we must make increasing preparations. The attacks in the air have slackened somewhat because of the weather, but they might easily have slackened in preparation for some other form of activity. I need hardly say, however, that every method of dealing with air fighting by night is being studied with passion and zeal by a very large number of extremely able and brilliant scientists and officers. So far we have been no more successful in stopping the German night raider than the Germans have been successful in stopping our aeroplanes that have ranged freely over Germany. We have struck very heavy blows; the blows at Mannheim appear to be of a very heavy character, and the enemy have not found any means of preventing them. So far we have not reached any satisfactory remedy, although we have noticed a considerable improvement in various directions. We must expect a continuance of these attacks and must bear them. The organisation of shelters, the improvement of sanitation and the endeavour to mitigate the extremely painful conditions under which many people have to get their night's rest—that is the first task of the Government at home. The A.R.P. services, the Home Office and the Ministry of Health are just as much in the front line of the battlefield as are the armoured columns which are chasing the Italian columns about the Libyan desert."

Air Strategy XXXIII

ITALY AS A TARGET—V

Pushing the Lower End of the Axis : A Wobble in the "Gyroscopic Wonder"

By
CAPTAIN NORMAN MACMILLAN, M.C., A.F.C.

This week Capt. Macmillan refers to the comparative scarcity of purely aeronautical targets in the southern zone. Lines of communication are, however, important.

WHETHER the war in Albania and the war on the desert borders of Egypt and Libya will deflect the air war away from the British Isles is a matter of speculation at the moment. It might even have the opposite effect of intensifying the German submarine and air blockade measures levelled at the security of the British Empire base which is the British Isles. Hitler and the German High Command are, presumably, working to a plan. So, too, must Churchill and his advisers work. The happenings in Albania and Egypt, therefore, must modify strategy if they affect the German war plan, but the probability is that they do not directly affect it.

With the situation on the Continent as it stands today, a straight fight between Britain and Germany is quite a big enough job to tackle without extraneous conflicts in out-of-the-way parts of the world. And so it seems a good thing to push Italy out of the Axis. It would be bound to cause a bit of a wobble in that gyroscopic wonder. It would have reactions in the Far and Near East, and it would clear the way for that straight fight.

There are many advantages to be derived from neutralising Italy but they can only be obtained to the full by her complete capitulation and the partial occupation of Italy by Allied troops. Does anyone imagine for a moment that if Italy were on the verge of collapse to the forces of the Allies, Germany would remain passive and stand idly by? At this precise moment Germany may not be interested in Albania or the Western Desert. But that does not mean she would remain indifferent to the fate of the Italian home peninsula.

It is wise to have regard to the effect of the fighting which has been initiated in Greece and the Western Desert by the aggressive, but puerile, military ventures of the forces who own allegiance to Mussolini. It would appear that there will be two principal effects. Assuming that the Allied fighting in both theatres is successful, all Italian possessions east of Italy and Libya will be completely cut off and the end of the Italian Empire (created in 1936) will occur with their capitulation. That is one principal effect whose repercussion will release large Allied forces for employment elsewhere. The other principal effect will be the neutralisation of the Black Sea, the partial opening up of the Adriatic, and the creation of conditions which would begin to make a direct military offensive against Italian home territory feasible, if difficult.

There are, of course, many subsidiary effects—the reduction in the effective fighting strength of Italy; perhaps the obtaining of still further naval bases for British ships in the Mediterranean; a step nearer the establishment of complete sea control over the Western basin of the Mediterranean by the Allies; a strategically better secured position to resist any Germanic thrust to the South-East, and the effect upon prestige among the European peoples both overrun and free, among the peoples of Asia and especially those of the Middle East, and last, but by no means least important, upon the people of the Americas.

Not Decisive

These are all important aspects in the immediate situation, but it must be admitted that, while they all tend in the right direction for the Allies, none of them has that decisive quality which promises an immediate change in the war situation which is likely to lead to an early termination of hostilities. Indeed, these present phases in the campaign are rather like the efforts of woodsmen to clear away the underbrush before they can get on the main job of felling the trees. Such, too, is the value in the whole war situation of the British occupation of the island of Crete.

Even if the offensives in Albania and the Western Desert should succeed in breaking up the Italian armies there and achieve the complete capitulation of the Italian forces in the Dodecanese, Eritrea, Somaliland and Abyssinia, will that bring victory? If the Italian mainland seemed likely to collapse would not Germany march into Northern Italy to give her an almost straight defence line from the Bay of Biscay to the Black Sea?

The real problem of this war is not how to win strategic side-shows but how to maintain the efficiency of our own base in the United Kingdom and simultaneously destroy the efficiency of the home bases of the enemy. To achieve that we must add the air-blockade to our sea blockade, just as Germany has added her air-blockade to her submarine blockade. I believe we could strangle Italy and Germany in much less time than was required in the first Great War if we employed our full resources to that end. That method would avoid the

ITALY AS A TARGET (CONTINUED)

terrific loss of life which must result from a direct military attack upon the German forces on the Continent.

Overwhelming Superiority Needed

But to be successful we must have the overwhelming independent power in the air which is the essential factor. How would the British Navy have been placed if it had begun the present war with the adverse ratio which the R.A.F. possessed? Why, then, must the R.A.F. always be expected to work miracles against odds which the Navy would not be expected to risk? It is not as though there were no work for the Air Force to do as an air force pure and simple. It is the only weapon we possess which can bring about a swifter reduction of the weight of air attack which has been borne so patiently by the British urban dwellers.

Why have our attacks upon the communication system of Germany eased off? Why have we made no air attacks upon the communication system of Italy? Owing to her geographical configuration, Italy is particularly vulnerable in the matter of communications. The answer seems to be that the claims of the Army and the Navy have resulted in squadrons of the R.A.F. being taken off their legitimate duties and made subservient to the older Services.

Except for the coastal road which skirts the Adriatic and a kind of by-pass from it that passes through Aquila, all the main roads leading from north to south pass through Rome. The main transverse road from Ostia through Rome to Pescara cuts all the road communications which lead into the South Area of Italy. There are only two trunk railway lines. North of this point there are only three important east coast ports—Ancona, Venice and Trieste. Why have all these vulnerable parts of Italy's communication system been left untouched?

Cutting Off the South

By the application of air power even on a relatively moderate scale the whole area of Southern Italy could be cut off so far as its main land communications are concerned and the sea communications to the south brought to a standstill thereby, while the ports in the Adriatic to the north could be put out of action or seriously impaired in efficiency. Italy would then be thrown back upon the use of ports in the north-west of her mainland, of which the principal is Genoa and the less important Spezia and Leghorn. The harbours of these three ports could be bombed, and as a result the complete communication system of Italy, by land and sea, would be thrown out of gear.

Those who make war have always been dependent on communications. The whole strategy of the British attack in the Western Desert was based on the cutting of the Italian communications between Libya and Sidi Barrani. The success of that stroke measured the success of the operation. It was the almost complete severance of our communications which caused the evacuation of the British Army from Dunkirk. Surely there is ample evidence of the desirability of extending this principle of out-manœuvring the enemy by the cutting of his communications? Nowhere can this be more readily done by aircraft than in Italy, and especially in relation to the southern area.

That is the important strategic aspect of the south area of Italy. There is not much aeronautical engineering activity within that area. At Naples Saiman make the Ro. types of aircraft, some of which have also been built by Caproni at Milan. There is also an aircraft repair works at Naples, where aircraft are repaired and parts made. There are workshops at Taranto and construction and repair shops at Castellamare di Stabia. So much for the air side.

In Naples marine engines are made, there is a locomotive works, chemical works and cotton mills. Industry does not elsewhere flourish along the languorous southern coastline or the barren mountain interior. The naval bases of Brindisi, Taranto, Catania and Augusta have all been raided from the air. Naples and its neighbourhood have also received attention. It might thus be assumed that we have done all that is necessary in this area of Italy. But that is not so until we have dealt with the inland communications; and, as I have shown, they are extremely vulnerable to air attack. The three areas into which I have divided Italy can each be cut apart from the others by a series of air raids. With attacks on a few important ports the whole of Italy can be thrown into confusion. Rail communications at Italy's northern frontier should be cut and, when the snow clears, the roads too. The ends of the axis should be severed. And, for the present, that can be done only from the air.

That Air Blockade Command

Some time ago in *Flight* I made a plea for the creation of an Air Blockade Command whose function would be the air blockade of Germany and Italy. It is the only way to guarantee that a proportion of our aircraft will be kept for that important purpose. At the moment the only Commands in the R.A.F. whose designations describe their functions are the Coastal Command and the Army Co-operation Command. The terms Bomber Command and Fighter Command mean nothing; squadrons can be taken from them to strengthen other Commands anywhere and no one outside the Service need be the wiser. That is why we need an Air Blockade Command dedicated to a particular duty. The efficient carrying out of that duty on the mainland of Europe every day and night when it is possible to operate would do more to shorten this war—and in the interval ameliorate the sufferings of the British people— than any other factor. Is it too much to ask the British people, who usually see things too late, to rub its eyes and see this one vital necessity in time?

CANADIAN AIR TRANSPORT ASSOCIATION

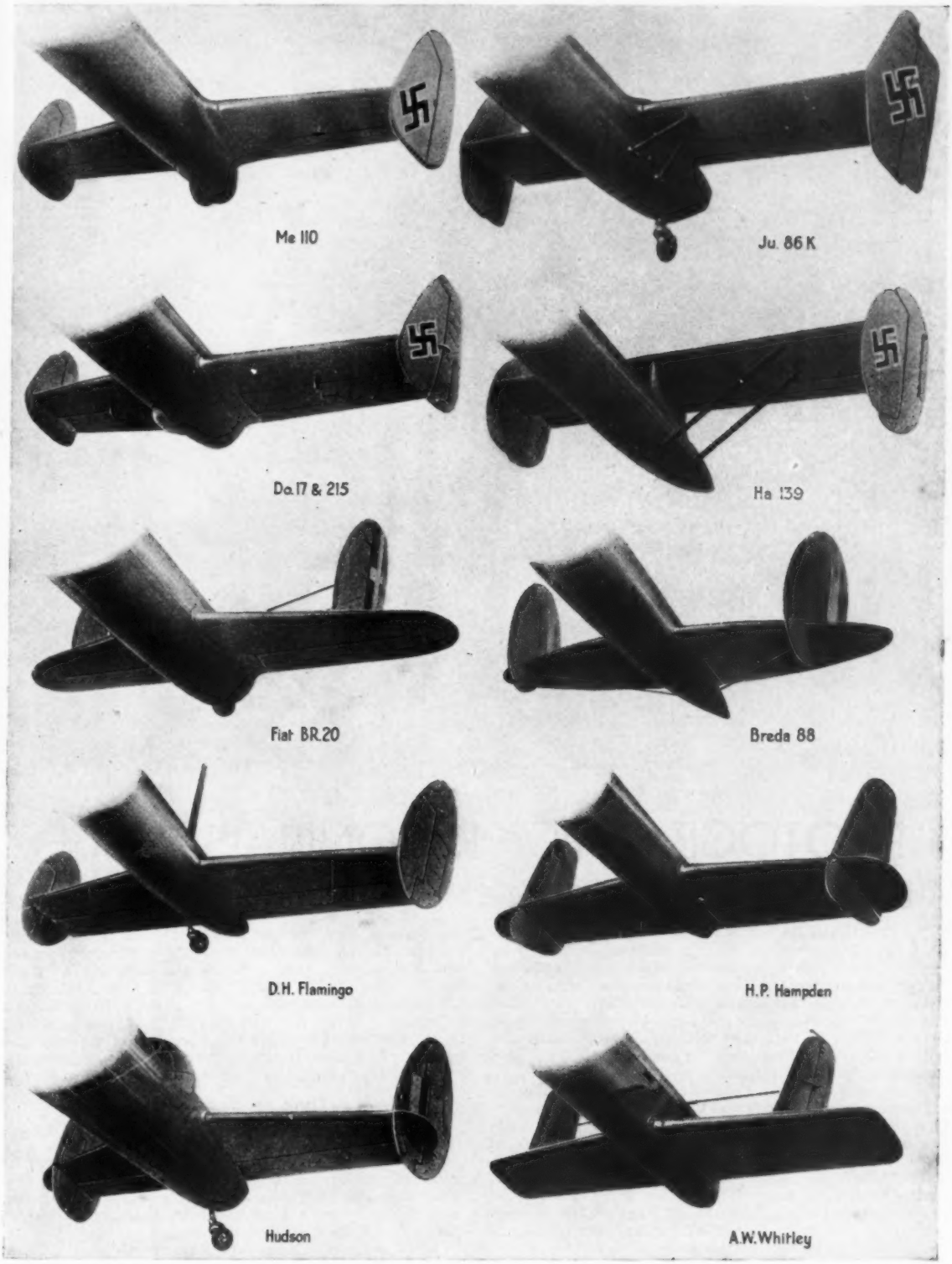
R. J. MOFFETT was re-elected president of the Air Transport Association of Canada at the annual meeting held in the Chateau Laurier, Ottawa, on November 18th and 19th. Other officers for the coming year are:—R. W. Starratt, Vice-President; D. S. Ormond, Hon. Secretary, and James Young, Hon. Treasurer. Directors include:—W. L. Brintnell, Mackenzie Air Service, Ltd.; W. N. Deisher, Fleet Aircraft, Ltd.; W. F. English, Trans-Canada Air Lines; R. B. C. Noorduyn, Noorduyn Aviation, Ltd., and G. A. Thompson, Canadian Airways, Ltd. W. B. Burchall was reappointed Executive Secretary.

Two days were devoted to business sessions and on the evening of November 18th a dinner was held at which the following government officials were guests: Ralph P. Bell, Director General, Aircraft Production, Dept. of Munitions and Supply; J. A. Cross, K.C., Chief Commissioner, Board of Transport Commissioners; Dean C. J. Mackenzie, Acting President, National Research Council and Air Commodore G. O. Johnson, representing the R.C.A.F.

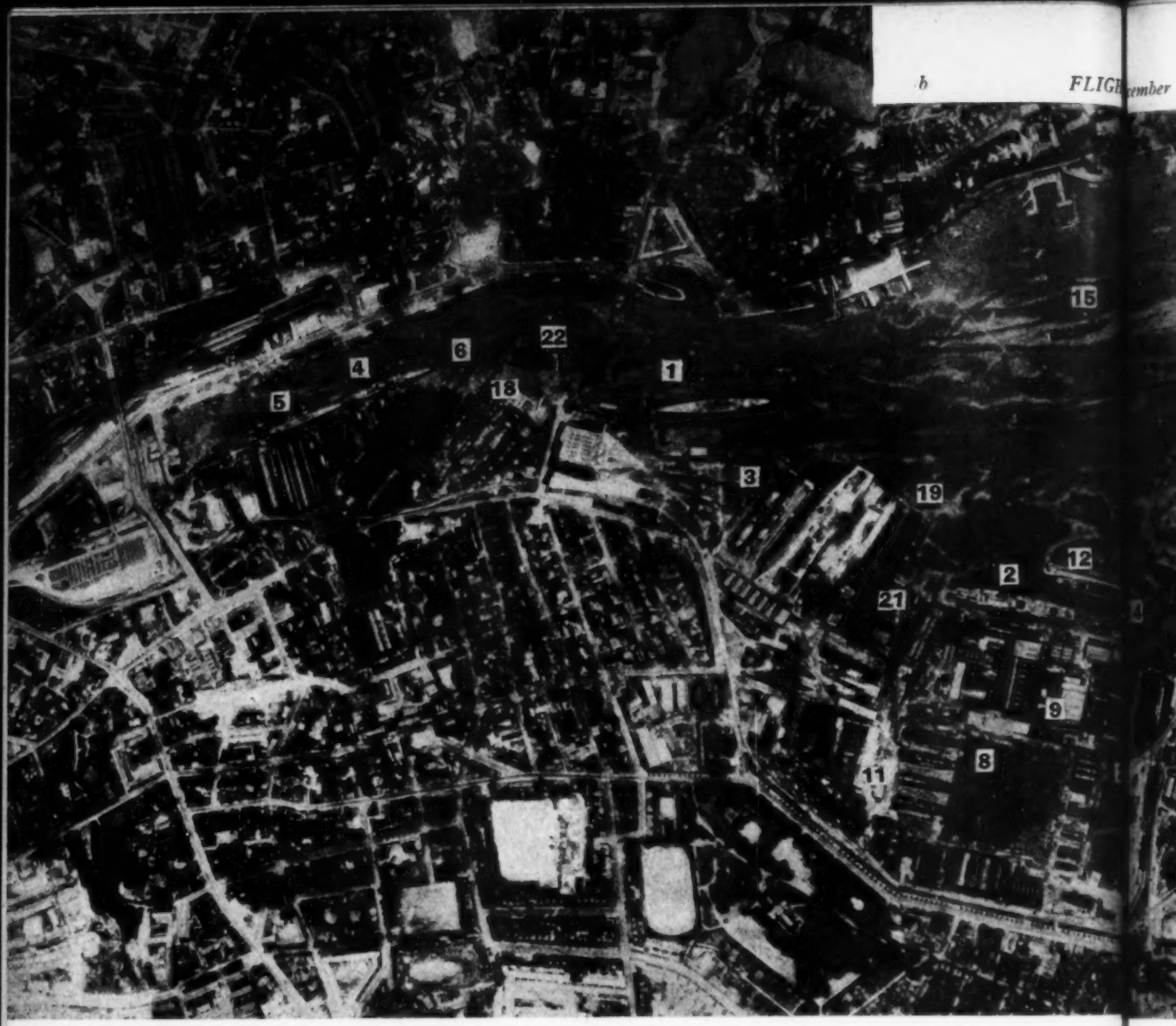
A silver salver, suitably inscribed was presented to R. J. Moffett, who has been President of the Association since its inception, by D. S. Ormond, Hon. Secretary.

Following the close of business on the second day an open session was held at which papers were presented.

SIMILAR BUT DIFFERENT



Comparative pictures by "J.P." of ten twin tails, all from the same angle : The twin arrangement of fins and rudders has advantages from both aerodynamical and military aspects. It gives the rear gunner an excellent field of fire, especially if the turret is placed fairly far aft. Smaller control areas can be used and, since these surfaces are in the airscrew slipstream, good control is obtained at low speeds.



PHOTOGRAPHIC RECONNAISSANCE

Day and Night Problems Solved by R.A.F.

DIVE-BOMBERS may have all the limelight; whatever the effect of nightly bombing on cities or munition works, to whatever degree T.S.R. machines may cripple an opposing Navy, reconnaissance remains one of the most important functions of aircraft in war. That was the responsibility laid upon them when they first went forth to battle in 1914, and without reconnaissance now neither Admirals nor Generals nor Air Marshals could plan the next step in a campaign.

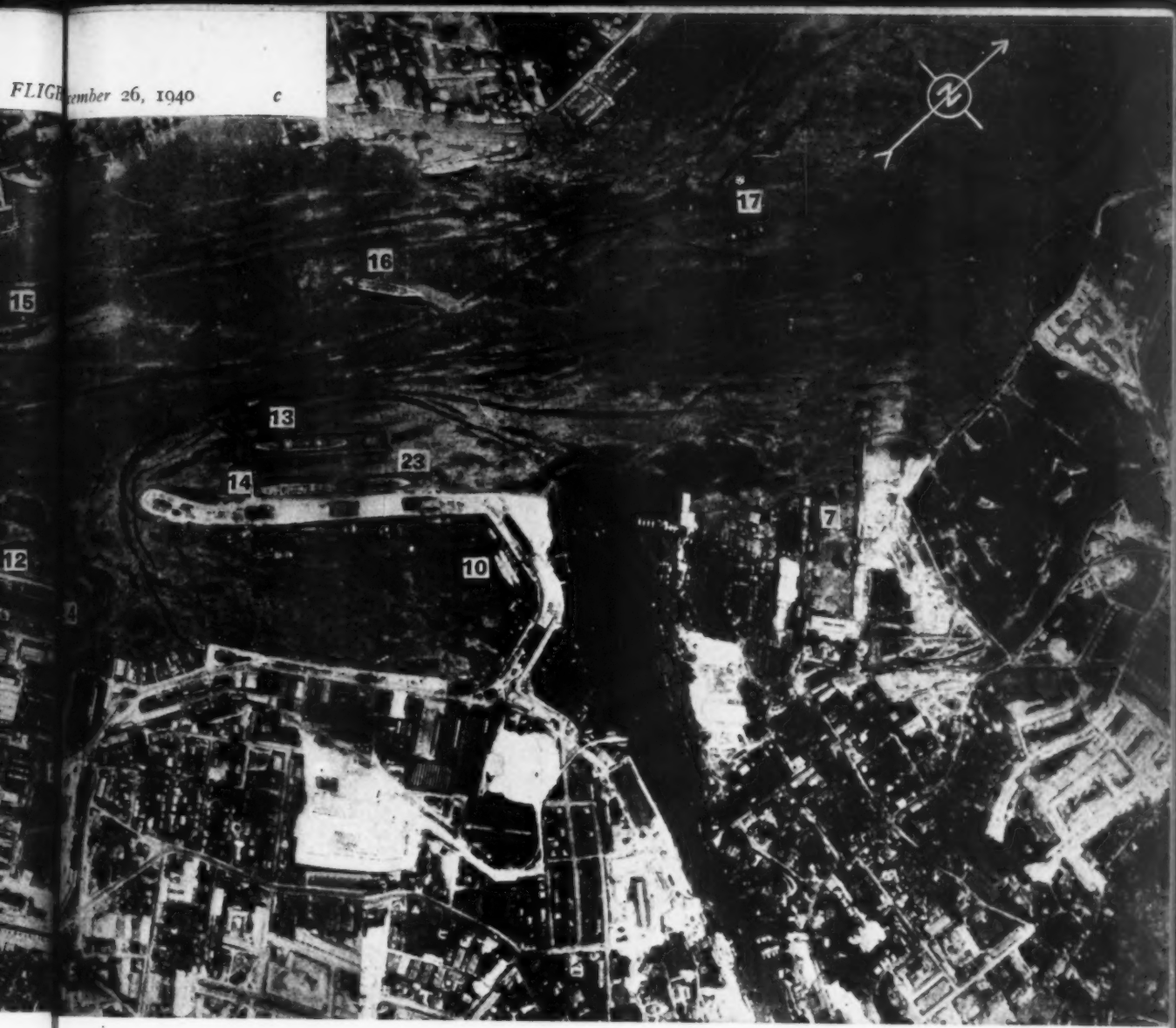
In the years which have passed since 1914 reconnaissance has become inextricably bound up with aerial photography. That development began early in the last war, and it has now been developed to a very high pitch of perfection. It is true that it needs a trained eye to decipher all the information which the aerial photograph can impart, as our readers must have realised when they scanned the aerial photographs published frequently in *Flight*. Those expert eyes exist, and no small part of our war effort, and the war effort of all belligerents, depends on them.

Advance in the accuracy of A.A. gunfire up to much greater heights has brought new problems to air photography. No longer can pictures be taken at some six to eight thousand feet with a ten-inch lens. Photographic reconnaissance has been forced up to the 20,000ft.-mark, and that, in itself, brought a train of extra problems to be solved. The cameras froze at that height, and the parts would not work. That difficulty was overcome by fairly obvious means. The R.A.F. could turn for guidance to the apparatus used by the members of the Houston Everest expedition. When that first difficulty had been overcome, it was found that condensation occurred on the lens, and a remedy had to be found for that. The research experts are not easily defeated by little problems like that.

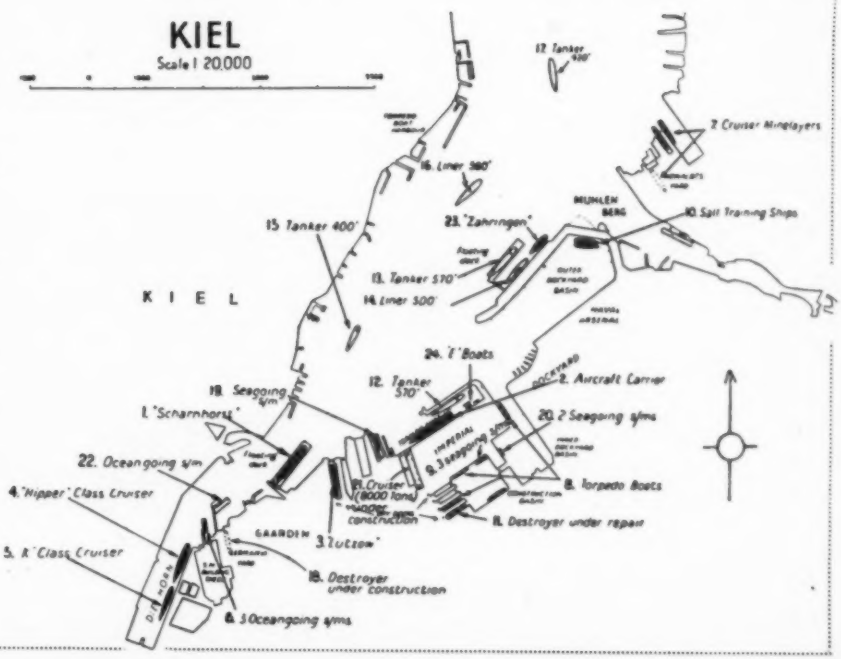
Long or Short Focus

Another problem was what scale to use. A wide-angle lens was out of the question at such heights, and when a narrow-angle lens was tried, it was found that the pilot frequently missed the target altogether. Experiments were made with the different lenses, to discover which was the most suitable, and a focal length, satisfactory for general purposes, has been decided upon.

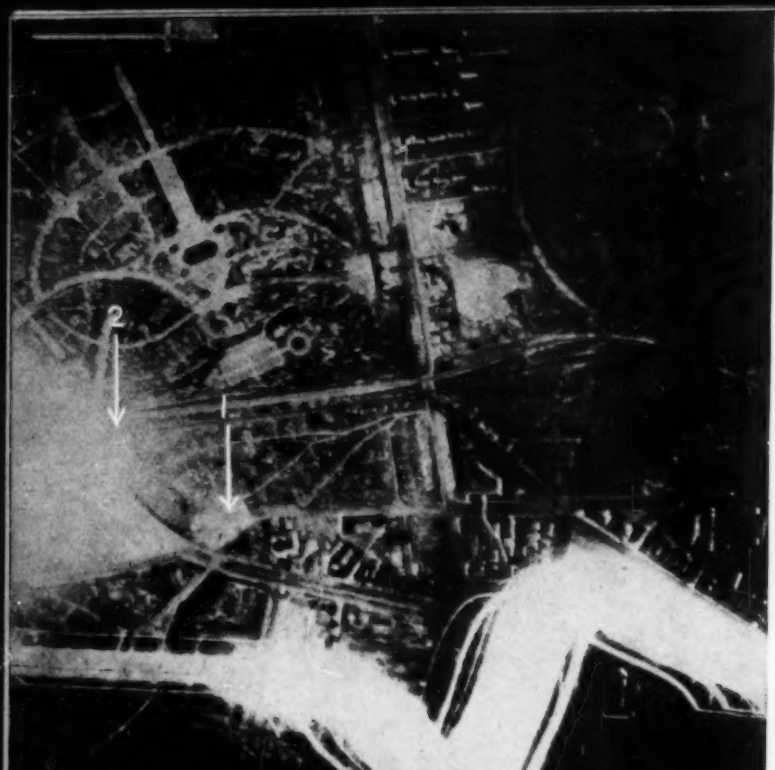
There are some things which cannot be photographed by daylight without quite undue risk to the pilot. As early as 1918 experiments were made in photographing by night. Flash-bombs are dropped to illumine the target. In peacetime it is difficult to get much practice in their use. The bombs make a noise and wake people up, or



MADE IN GERMANY : Here is one of the R.A.F.'s finest examples of the art of photographic reconnaissance. It shows clearly all the activities taking place in Kiel Harbour, and the information is indisputable. For instance, No. 1 shows the German battleship *Scharnhorst* in a dark rectangle. This undoubtedly means that it is undergoing repairs in a floating dock. Again, No. 2 indicates an aircraft-carrier, presumably the *Graf Zeppelin*, under construction. The two dark squares in the deck probably indicate the position of the aircraft lift-shafts. A careful survey of a photographic map such as this gives our naval authorities a fair idea of what is likely to happen for some considerable time ahead, and the light streaks all over the water gives the immediate information that our bombers were successful in hitting oil supplies the night before.



PHOTOGRAPHIC RECONNAISSANCE (CONTINUED)



LIGHT IN A DARK PLACE: A night photograph taken by flash bomb during a raid on Stettin. No. 1 and 2 show bomb bursts close to a railway viaduct. The broad white band is the path made by a searchlight during the period in which the camera shutter is open.

frighten them, and the bomb has to drop somewhere after doing its work, and it may hit something which it ought not to hit. One would imagine Laffans Plain at Aldershot a fairly safe place to make experiments of that sort, but once when a flash-bomb was dropped there in peacetime, it discovered the only house for miles around and went slap through the roof. What the occupier said is not on record.

When working with flash-bombs, the shutter of the camera is opened one second before the bomb ignites, and the flash of light closes the shutter. Since the shutter is light-operated a trouble is that searchlights can cause it to close before the bomb explodes, and in this case no picture of the target is obtained. In fact, searchlights and tracer bullets are a standing nuisance to the night photographer. This is not only because the shutter may be caused to close prematurely, but because the streaks from the tracers and searchlight beams are photographed for the whole second during which the camera shutter is open. He has to take his chance with them, and he sometimes gets very gratifying and useful results.

The photographic authorities at the Air Ministry are convinced that British lenses are now superior to the best which the German optical industry can produce, and also that British cameras are much neater and lighter than those found on captured German machines. If they thought the German stuff better they would certainly use it on our own machines, but they have felt no inclination to do so. They are also convinced that our method of installation in the aeroplane is superior to the German method. Considering how "made in Germany" has been a term to conjure with in the photographic world for so many years, it is refreshing to hear that Britain has taken the lead.

NEW RESCUE LAUNCH

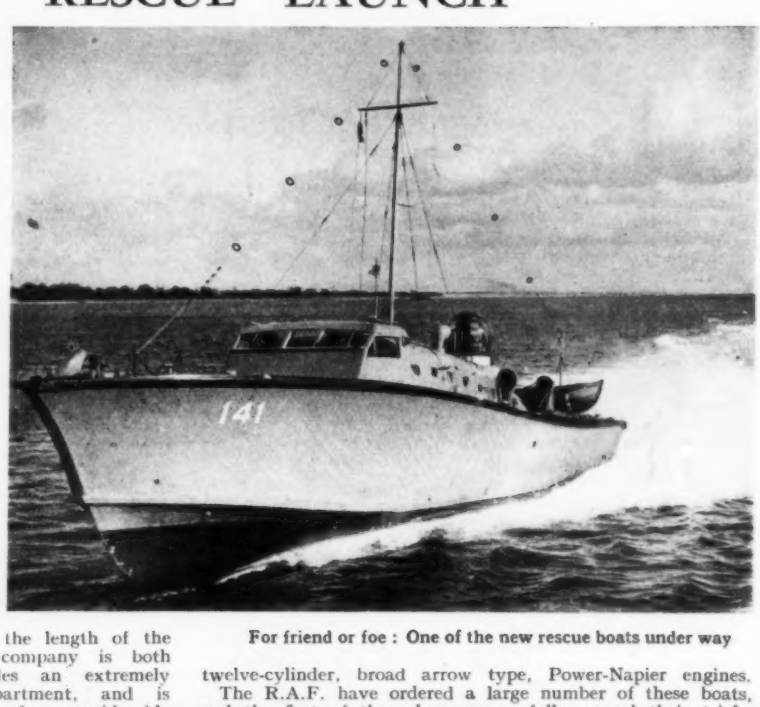
Power 63-footer for the R.A.F.

THIS new launch, designed by Hubert Scott-Paine, exemplifies his latest ideas which were incorporated for the first time in the 70ft. motor torpedo boat produced just before the war. The new form of structure combines a further reduction in weight with added strength.

It would not be expected that boats of this size would count weatherliness as one of their virtues, but this new 63-footer really is remarkable as a sea boat—quite equal to the Power Boat Company's 60ft. and 64ft. craft, which are noted in this respect. Rescue facilities provide for five stretcher cases in normal circumstances, with a sixth for emergency purposes. The rescue apparatus fitted includes rope jumping ladders and a specially designed hatch in the superstructure to facilitate the handling of stretcher cases. There is also a gun turret to discourage attention by enemy bombers during a rescue.

All parts of the boat are accessible under cover from the wheelhouse. The wheelhouse and deckhouse extend from the aft end of the crew's quarters to the fore end of the engine room, allowing free movement of the crew throughout the length of the ship. Accommodation for the ship's company is both spacious and comfortable. It includes an extremely well-equipped galley and toilet compartment, and is fully habitable for a crew of nine for considerable periods at sea. The boat is powered with three 500 h.p. twelve-cylinder, broad arrow type, Power-Napier engines.

The R.A.F. have ordered a large number of these boats, and the first of them have successfully passed their trials, but it is not permitted to state the speed attained.



For friend or foe: One of the new rescue boats under way

Supplement to FLIGHT

THE AIRCRAFT ENGINEER

No. 178. (Volume XIX No. 11) 15th Year December 26, 1940

THE TWO-STROKE DIESEL ENGINE

An Unorthodox Design : Piston-type Blower Advocated : Buried Engines and Pusher Airscrews

ON March 14th, 1881, Sir Dugald Clerk filed his patent specification, "Improvements in Motors worked by Combustible Gas or Vapour." This was the birth of the two-stroke or two-cycle engine. Despite certain obvious advantages, it is only in recent years that the two-stroke has been closely studied. In 1932 Sir Dugald Clerk wrote: "The two-cycle engine is worthy of great attention, and the best type will be in the form of a heavy-oil engine of the compression-ignition type." Sir Dugald Clerk's opinions carry great weight, and there is a rapidly growing opinion that the two-stroke has been neglected far too long.

Mr. W. S. Burn, in his paper on "The Application of the Two-stroke Heavy-oil Engine to Aircraft Propulsion," read before the North-East Coast Institution of Engineers and Shipbuilders in Newcastle-on-Tyne earlier in the year, definitely comes down on the side of the two-stroke. At the beginning of his paper he outlines the potential advantages of the two-stroke heavy-oil engine over the four-stroke petrol engine. In his summary the author gives his opinion that reduced engine weights are fundamentally possible, and that among the advantages of the two-stroke are: greater reliability; less fire risk; greater radius of action; cheaper running costs; elimination of electrical ignition and consequent elimination of radio interference; no carburation troubles; greater simplicity of control; easier overhauls, easier cooling; greater power for a given weight; better performance at altitude and more reliable starting.

A formidable list of advantages which was by no means accepted by those whom Mr. Burn describes as suffering "from a particularly strong petrol complex."

Past Experience

High spots in Diesel aero-engine development are represented by the following makes: Junkers Jumo; Packard; Deschamps; Guiberson; Clerget; Coatalen; Salmson; Talbot; Zod; Beardmore; Bristol Phœnix; Rolls-Royce Condor; and various British experimental sleeve-valve types. The chief developments have been made abroad, and the greatest progress has been made by the two-piston Junkers engine, the only commercial type.

Practically all of the various aero forms of engines have been experimented upon, chiefly the four-stroke type, from 250 to 1,000 h.p. The weight so far has been usually unattractive at about 2¼ to 3 lb./b.h.p., and the fuel consumption at about 0.38 lb./b.h.p./hr., although the Coatalen engine claims to be as low as 0.3 lb./b.h.p./hr.

In describing briefly the Junkers engine the author pointed out an interesting development, namely, the reduction of the total stroke-bore ratio which is 5:1 with the Jumo 206 (the latest type), 6:1 in the Jumo 205, and 7:1 in the Jumo 204. The scavenging excess-air ratio has, it is stated, been reduced from 1.6 to 1.3; the b.m.e.p. increased to as high as 135 lb./sq. in. As the type is fundamentally heavy, due to the necessity for two crankshafts and crankcases, the progress made is very creditable.

"An investigation of diesel aero designs to date seems to indicate," said Mr. Burn, "that the chief inadequacy has been in the exact fuel injection, and perhaps in the lack of air-controlled movement or turbulence—to give a regulated and complete combustion with high m.e.p., low maximum pressures, and good fuel consumptions. Nearly unlimited air supply will only enable high mean pressures with inferior fuel consumptions.

Marine Development

"It is curious," said the author, "that while the four-stroke marine diesel engine has been almost completely replaced by two-stroke single- and double-acting engines for some years past, for reasons of reduced weight, cost and fuel consumption, the aero-engine has gone steadily along on its uneconomical four-stroke petrol-consuming course, with step-by-step improvements until consumptions of 0.44 lb./b.h.p./hr. are possible. . . . Commercial aero-engines have increased no less than three times in power output from given cylinder dimensions in fifteen years, a figure almost identical with that of certain well-known large slow-speed marine diesel engines; but while in the former case the improvement is due to increases in b.m.e.p. and r.p.m., in the case of the marine engine it is chiefly due to change of type, the mean pressure and revolutions remaining almost the same due to heat stress and propeller limitations respectively.

"The overwhelming need for a suitable heavy-oil engine is demonstrated only too clearly by figures for a large Transatlantic flying boat given in a lecture by Mr. Gouge," said Mr. Burn. "With six 1,300 h.p. engines and an economic cruising speed of 237 m.p.h., the total weight of 163,000 lb. is made up as follows:—

Power units	23,320 lb.	Equipment	8,700 lb.
Tankage ..	2,670 lb.	Fuel ..	62,350 lb.
Structure ..	54,110 lb.	Pay load and crew ..	11,850 lb.

"Discussing these figures," the author continued, "the prime importance of improvement in fuel consumption is shown by one glance at the fuel weight. Engine weight would appear to be almost a secondary matter. Another striking feature is the large power required to propel such a small useful load. With regard to engine weight, there is a tendency to require much greater reliability and reduced maintenance, and to halve the increase in specific output. Weight reduction will therefore become increasingly difficult to obtain. There will still be considerable scope for improvement in aerodynamic efficiency, but the greatest scope will be in radical reduction in engine drag, and improvement in fuel consumption by the adoption of C.I., the two-stroke cycle, exhaust efflux and even cooling

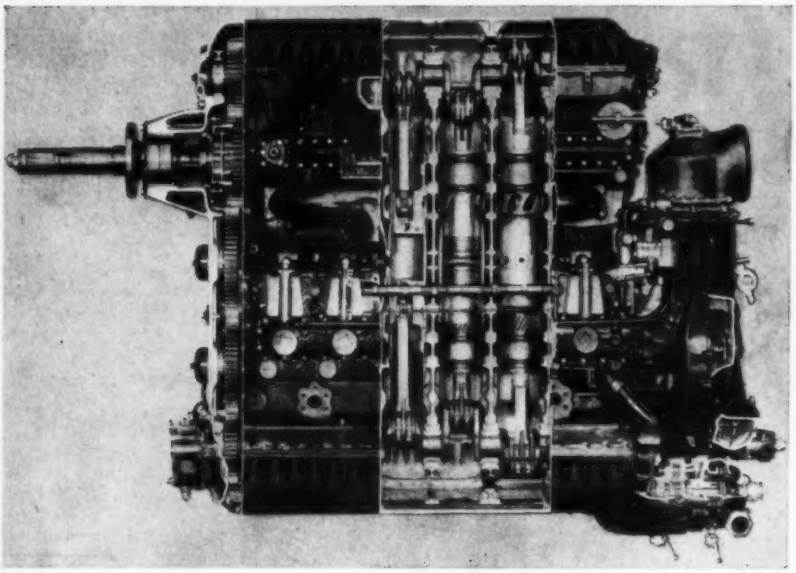


Fig. 1. The Junkers Jumo opposed-piston, two-crankshaft heavy-oil engine.

THE TWO-STR

propulsion. A cleaned-up leading edge, and the use of integral fuel tanks, will tend to more economic wing structure." Mr. Burn summarised the above improvements which can be effected in the propulsion of aircraft in eight sections, the first being the fitting of the engine completely within the wing to obviate interference drag and to facilitate the use of pusher screws.

Mr. Burn rushes in where aero-engine angels have, as yet, trod with the greatest discretion, and not only discusses what should be the correct basic aero-engine type, but proceeds to design such an engine. Considering the many engine types in service, the variation in existing design indicates the wide possibilities and suggests the mapping out of a new course guided by fundamentals rather than practice.

"The suggestion that some form of flat engine will be the ultimate solution becomes more and more insistent. . . . The present tendency of increasing the number of cylinders is evidence that present engine development is going to seed.

"A review of the whole gamut of petrol engine types reveals that even from weight considerations alone it is necessary to leave the petrol engine system and adopt some other combustion system which is free of cylinder size limitations for reasons of specific output and fuel economy. . . . The type trend will, therefore, be to compression ignition, the two-stroke cycle, and the smallest number of horizontally opposed cylinders. . . . Any in-line type can be adapted to be a "flat" opposed-cylinder type, which would lend itself to meticulous fuel-injection control as arranged in, say, the Coatalen engine."

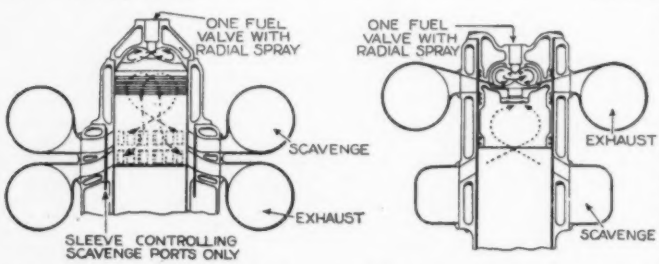
Various Valve Types

Fig. 2 shows the poppet-valve type, with a single exhaust valve combining a good gas flow with a dual-turbulence insulated combustion chamber in the cylinder cover, and yet possesses a reasonable gas flow for exhausting. The short piston and short length of cylinder will make for low weight. The figure also shows the single-piston double-flow scavenge type, so popular in marine engines, which should not be ruled out. It is significant to note that a rather similar design was patented by Junkers. For comparison the differential-stroke opposed-piston construction, showing the very straightforward cylinder construction possible, is given.

Said Mr. Burn: "I will propose what I believe is an entirely new engine type to the aeronautical world, even if it has as a basis a type well known to the shipping industry, namely, the slide-rod opposed piston engine. I will also be a renegade to the aero-engine fashion and endeavour to give the aeroplane designer just what he wants—that it, an accommodating sort of engine, and one that will not interfere with his desire for perfect aerodynamic forms."

The author believes the pusher type of aeroplane will be the future type, and from that argues that an engine must not only be completely located in the wing without nacelles and with the neatest of propeller bossings, but must be in the trailing edge section as near to the trailing edge as possible. Hence the engines must be not only of horizontal form, but of as small a depth as possible.

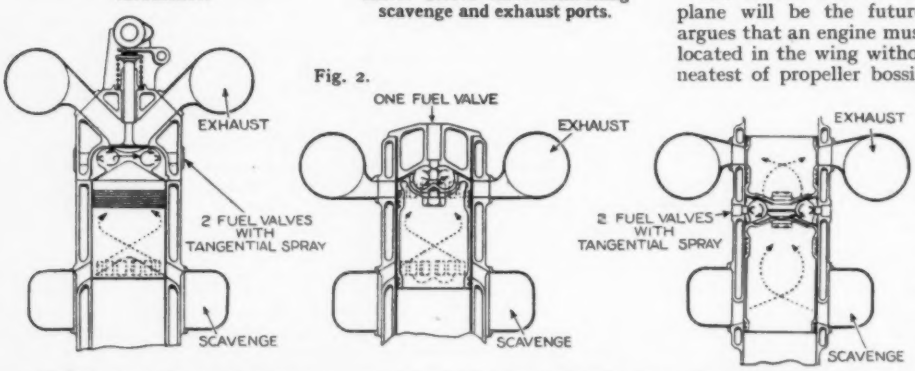
Argument used to justify the use of engine nacelles is that in the case of the high-wing monoplane they afford a location for the retractable undercarriage, as in the D.H. Flamingo; but doubtless other



Double-flow scavenging. Dual turbulence.

Uniflow scavenge. Dual turbulence. Sleeve valve controlling scavenge and exhaust ports.

Fig. 2.



Valve in head. Dual turbulence.

Uniflow scavenge. Dual turbulence. Sleeve-valve-controlled exhaust

Opposed piston. Dual turbulence (effective stroke and power 50% greater).

DIESEL AERO ENGINE (CONTINUED)

means will be found to do this. One suggestion to enable the undercarriage to be carried efficiently is to accommodate it in a small cantilever variable-incidence low-wing, as shown in Fig. 4, when some useful and controllable lift is obtained with relatively small drag, at the same time eliminating all interference drag on the main wings.

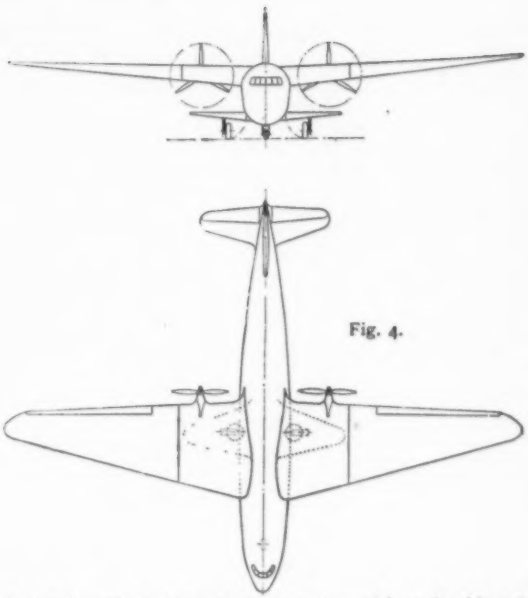


Fig. 4.

Engine Accessibility

The thickest section of the wing should be reserved, in the larger aeroplane, as a passage way to gain accessibility to the engines. As a tractor screw at the leading edge must be about 25 per cent. of its diameter forward of the leading edge, placing the engine towards the trailing edge and using pusher screws will eventually entail the shortest shafting and thereby reduce weight. Once the engine is established in the wing, with pusher airscrews, the tendency will be to encourage the high-wing monoplane.

As a major advantage of the oil engine is that it imposes no limitation on cylinder size, and as there is ample wing span, an oil engine can be of almost unlimited length in a horizontal plane. "I am firmly of the opinion," said the author, "that once the decision is made to depart from the present conception of an aero engine being either a compact radial or in-line type of minimum frontal area, and to start making the fullest use of the one dimension which gives unlimited scope, i.e., horizontal length, the diesel engine for aircraft will rapidly go from strength to strength.

"The engine I am going to propose for 2,100 b.h.p. will have only six opposed-piston cylinders, three on each side of the crankshaft, but there will, of course, be twelve pistons in all, six controlling the air inlet and six the exhaust. The diameter of the proposed cylinder is 7in., and the combined stroke 12in. at the above power. The b.m.e.p. is 150 lb. per sq. in., and the r.p.m. 2,000."

Scavenging

In the course of a detailed description of the author's proposed design, he stated: "The most important problem of the two-stroke cycle is that of the complete evacuation of exhaust products and their replenishment with pure air. The propulsion of the air into the cylinder must be done with a minimum of power; therefore the air route must be as short and direct as possible. These and other requirements are best accomplished by using ports in the cylinder bore, arranged as far as possible completely around its full circumference. The proposed horizontal arrangement of cylinders offers the greatest advantage for the two-stroke type of cylinder, inasmuch as there is complete freedom to utilise two large-area, highly efficient exhaust pipes per cylinder, with an excellent gas flow. As a correctly-shaped combustion space is a fundamental necessity of any type of heavy oil engine, this should be arranged chiefly from the point of view of obtaining the best fuel and air distribution. The problem is to obtain the ideal combustion space and scavenging system without exposing either the pistons or cylinder bores to excessive heating effects. This inevitably necessitates some form of double-piston construction.

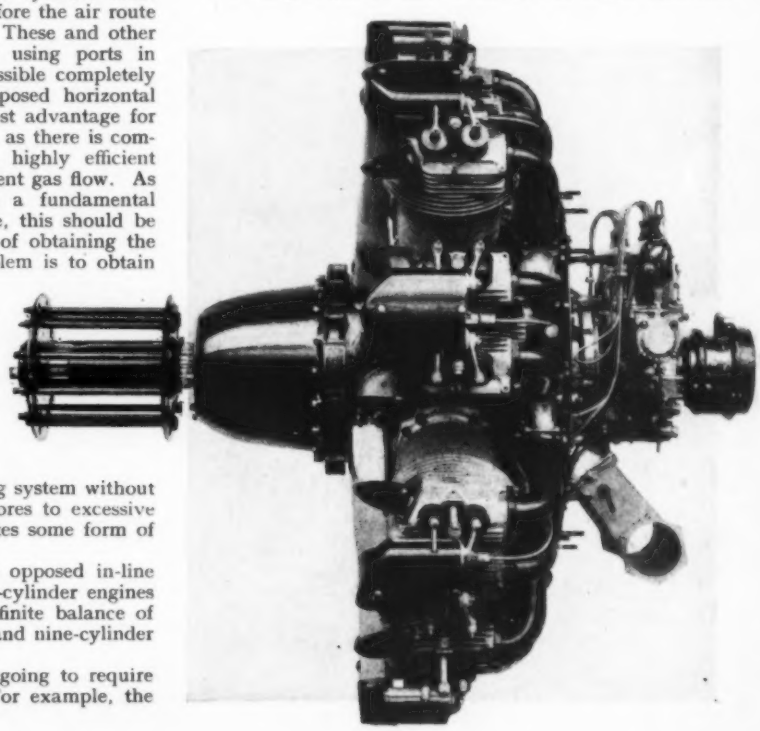


Fig. 3. The Bristol Phœnix diesel engine established a world's record by reaching a height of 27,450ft

"Figs. 5 and 6 show the horizontally opposed in-line arrangement proposed. The six- or eight-cylinder engines for the two-stroke opposed type have definite balance of advantages (over the twelve-cylinder vee and nine-cylinder radial).

"It is obvious that such an engine is going to require an entirely different design technique. For example, the side tension rods and bearings; the sleeve side-rod guides; the ported, oil-cooled cylinder liners; the composite and oil-cooled pistons; hot combustion-space parts; the three-throw crankshaft with quite different lightening arrangements; the special fuel injection equipment; scavenge air pumps; and the altered exhaust technique. The mere fact of having an accessible engine whose parts can easily be renewed and replaced piecemeal, instead of removing the entire engine, will tend to a different conception of designing.

"The cylinder jackets are made separate for each cylinder, aluminium alloy castings, in two parts, bolted together in way of the combustion chamber. The liners are in two pieces, bolted together about a central belt with the protecting combustion ring held between them.

"Oil engine pistons have a number of design considera-

THE TWO-STROKE DIESEL AERO ENGINE (CONTINUED)

tions requiring quite different treatment compared with normal petrol engine practice. For example, the piston crowns should be at as high a temperature as possible to reduce heat losses and maintain the highest ignition temperature. An oil-tight gudgeon is essential. The proposed piston is one of composite construction, the crown and skirt being in one part from an alloy steel pressing, surrounding a forged, light alloy central portion in which are formed the gudgeon inside bearings. A heat-resisting steel cap prevents heat travelling down via the outside in which the piston rings are held. All three pistons are held together by a single central bolt for reasons of possible differential expansion. This is shown in Figs. 5 and 6, while Fig. 7 gives a comparison with the Junkers design.

"The design of an efficient scavenge pump is the most difficult feature of any two-stroke engine; therefore, to start with, the scavenge pressure and excess volume required should be as low as possible."

Mr. Burn indicated that there is some doubt whether the air displacement and pressure characteristics of the centrifugal blower (which is usually employed) with variations of speed, conforms with the desired requirements. An advantage of the centrifugal blower is that it has been continuously developed for a number of years as a supercharger and can deliver up to 15 or 20 lb./sq. in. pressure. It must be kept in mind, however, that the fuel consumption and output of the Junkers Jumo were, until recently, seriously handicapped by the relatively inefficient centrifugal blower, and in the present state of the development

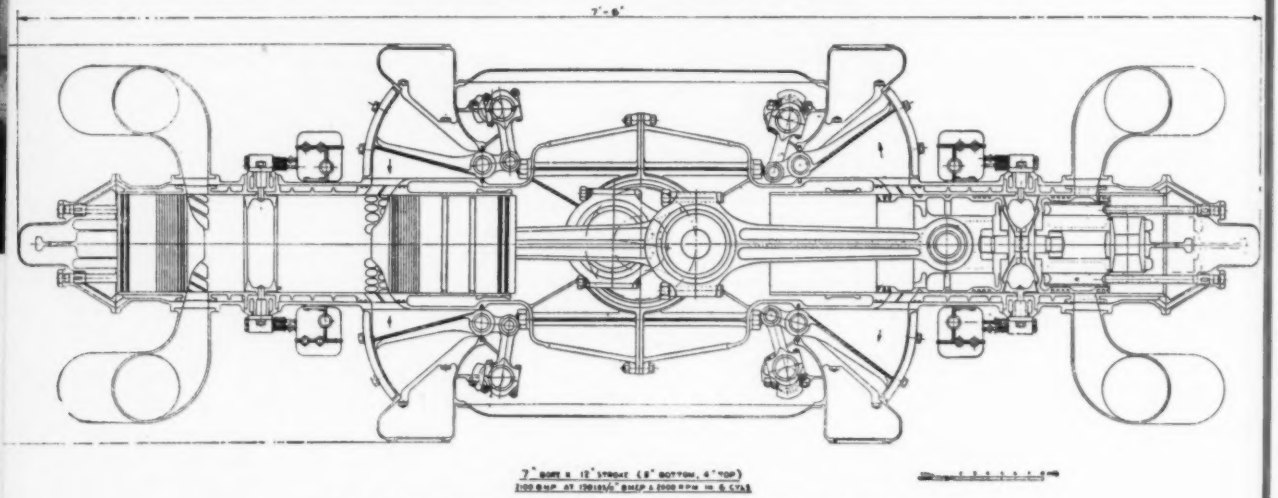


Fig. 5. Horizontally opposed piston and cylinder heavy oil aero engine.

Fig. 6. Part-sectioned plan view of the diesel aero engine proposed by Mr. Burn.

THE TWO-STROKE DIESEL AERO ENGINE (CONTINUED)

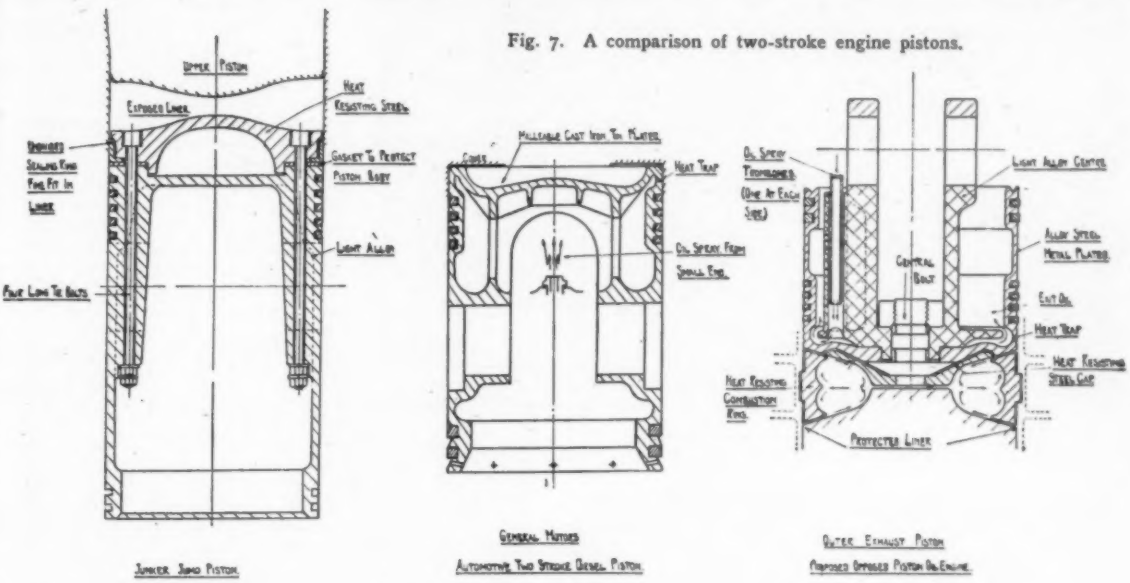


Fig. 7. A comparison of two-stroke engine pistons.

of both radial and axial flow blowers there is a definite incentive to develop the simplest form of piston displacer type of scavenge pump. Even the most efficient type of Rolls-Royce blower, said to be 73 per cent., is not as good as can be readily obtained with simple parts from a displacement-type pump which has an efficiency of 85 to 90 per cent. Noise and the complete dependence on the engine are other defects. Constant air pressure rotary blowers of the Rootes type, even after years of development, consume the excessive figure of 15 per cent. of the total power developed by the engine. A normal figure for a large marine oil engine does not exceed 4 to 5 per cent., using plain reciprocating blowers with automatic or mechanically-operated valves. The pump design proposed will provide:—

(1) A blower of maximum efficiency by giving as far as possible a uniflow movement of the air and at the same time, making full use of the kinetic energy imparted to the column of air by the flap.

(2) The simplest possible system of moving parts. The oscillating flap or displacer type of piston being chosen as enabling the smallest and lightest operating rods to be used with a minimum of friction or lubricating surfaces.

(3) A timed air supply.

The layout of the engine in the wings is shown in Fig. 8. Mr. Burn summarises the expected advantages of the proposed engine compared with accepted petrol engines as follows:—

1. At least 25 per cent. improved fuel economy on a test-bench basis, and still greater economy in service.
2. Geometric form of engine suited to efficient aerodynamic design.
3. No greater weight at greatly reduced revolutions and mean pressures without greater maximum pressures, and hence, ultimately, much greater reliability, reduced service charges and longer life.
4. Much higher degree of exhaust efflux propulsion than any existing engine type.
5. Reduced cooling losses, and the chance of a slightly positive propulsion from the oil cooler.
6. More completely balanced engine dynamically.
7. Almost unloaded main bearings.
8. All connecting-rod bearings are unidirectionally loaded to give permanent silence and freedom from vibration, even if bearing wear takes place.
9. Outstanding accessibility without equal in present aeroplane engines.
10. Reduced weight of wing structure and fuel tankage.

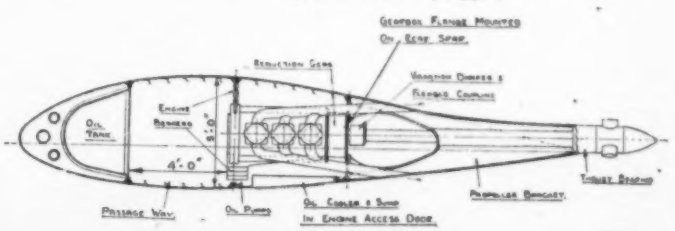


Fig. 8. Section through wing showing layout of 2,100 b.h.p engine within the wing with propeller bracket, exhaust system and oil cooler.

Discussion

The discussion was opened by MR. K. O. KELLER. He could not help feeling that the author's technical knowledge outran the practical difficulties. It must be understood that low fuel consumptions were more easily obtained in a slow-running engine than in a high-speed engine, and for this reason he had to dampen the author's enthusiasm to reach a consumption of 0.32 lb. per b.h.p. In the engine put forward by the author he proposed that scavenging air should be 10 per cent. in excess of stroke-bore volume. He ventured to say that this would account for a few per cent. increase in consumption. The author claimed to obtain maximum combustion efficiency with a low compression pressure. Practical experience would tell him that the reverse was the case.

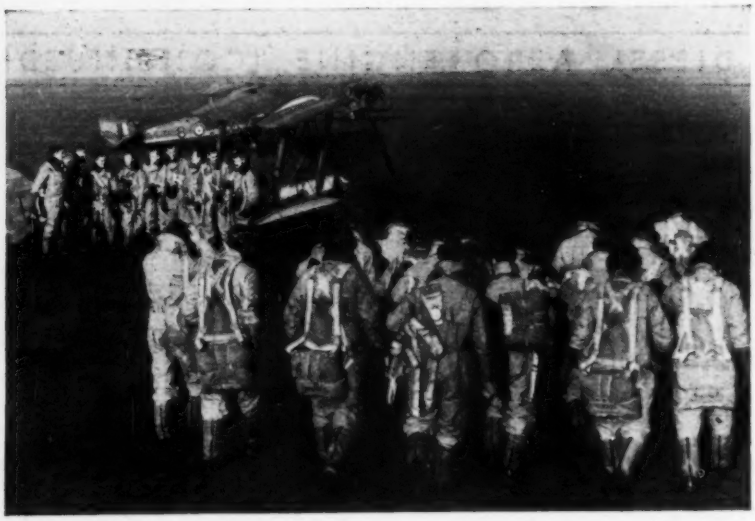
DR. T. W. F. BROWN did not agree with the author's thesis that an oil engine for aircraft can be developed from considerations of large marine diesels. The 10 per cent. excess air for a b.m.e.p. of 150 lb. per sq. in. was far too low. Very careful experiment would be necessary to ensure that the shape of the compression space would enable reasonable ignition lags to be obtained; otherwise there was no hope of a fuel consumption being obtained that would be better than at present for the petrol engine. The author stated that the fewer and larger the number of

(*Continued on p. 552.*)

R.A.F. INSU[CTION]

Visit to an Air Obse[rvers'] Navigat[ion School]
Elementary F[lying] Train[ing School]

Illustrat[ions] "pho[tographs]"



CHANGE-OVER : A new batch of pupils after classroom instruction goes out for flying practice and takes over the aircraft which the former batch have just used.

IN an Anson at two thousand feet; beneath is Midland farm country, with a certain amount of industrial haze lying over it. We are flying just at the upper level of the haze and above it is the clear winter sky of afternoon. Plugging into the "intercomm.," one hears, spoken very slowly and deliberately:

"Can you hear me, observer? . . . Can you hear me, observer?"

"Yes, I can hear you, pilot." . . . Long pause, then in the sing-song of absolute clarity, the pilot says:

"Turning on now . . . turning on now . . . running on now . . . running on now . . . steady on now . . . steady on now. . . ."

A pause, then the observer's voice, "Right . . . right a little . . . left . . . steady . . . left . . . steady." Then, with obvious relief of tension: "O.K. pinpoint" was heard and another photo had been taken.

This was the second target to be photographed on this exercise for pupils of the Air Observers Navigation School. On a visit to inspect the work of this School and of the Elementary Flying Training School at the same aerodrome, we had been allowed to go on one of their navigation flights for map reading work. Suitably clad against the cold weather we climbed aboard the Anson. Next to the experienced pilot (he had fought alongside the Australians in the last war in Mesopotamia) sat the pupil observer, a leading aircraftman of boyish demeanour, who had been set the task of navigating the Anson on a triangular course and of taking a photograph of a small objective near, but not at, each of the two "away" corners of the triangle. And though the exercise was a short one involving only about 150 miles of flying, a radio operator was aboard to maintain communication with the base and make everything a real "small-scale" bombing or reconnaissance flight. We had even been "briefed" by the C.O. of the School before setting out.

BOMB-SIGHT : The instructor demonstrates the working of the Wimperis type of bomb-sight to air observers.

Visibility was not at all good, and as we set course for the first target, after climbing, it was evident that we would have to stay at about 2,000 feet to identify landmarks. The observer entered up the log as the country unwound itself beneath us and made frequent references to the one inch to the mile map to keep the machine on course. The busy chatter of the morse reporting to the aerodrome could be heard

LEARNING ON THE LINK : The instructor demonstrates to the pupil how to make a "cross-country flight" on the ground, and then, at his desk, acts as "radio station" and gives the pupil bearings as he watches the progress of the flight being plotted.

NSTRUCTION

Observation School and an ary Flying School

Illustrated" photographs

DUAL INSTRUCTION : As one Tiger Moth comes in to land, the other sits still on the ground so that the landing can be made without confusion.

GUNNERY : Air gunners get armament instruction and practice at targets on the range with machine guns.

through the headphones on the "inter-comm." It was not long before we came to the first corner of the triangle, a large and easily identifiable country house. One turn round this and then along the road which led to the small inn which had to be photographed. This was found, but the run up to it was not satisfactory and the objective could not be centred in the lens. So the observer called for another run and, directing the pilot with his "right . . . more right . . . steady . . . left . . . steady . . . O.K., got it," the inn was photographed. And so on to the next leg of the triangle and the second objective. As before, the corner of the triangle was found first and then a road used to lead right to the target. No trouble this time—the observer was getting better. And this after having had only about three or four hours in the air—it was his first attempt at such an exercise, and well done.

Details of Observers' Training

The air observer is a very important man in a bomber crew. As navigator he is responsible for directing the aeroplane to its target and back again. He is the man in the team to whom the pilot, in charge of the aircraft, refers questions of courses, times, routes, weather, heights, available petrol, and other vital matters. On the quality of his work depends the success of every bombing raid, sea patrol and reconnaissance. And in his rôle of air gunner, he may also be called upon to defend the machine against hostile aircraft.

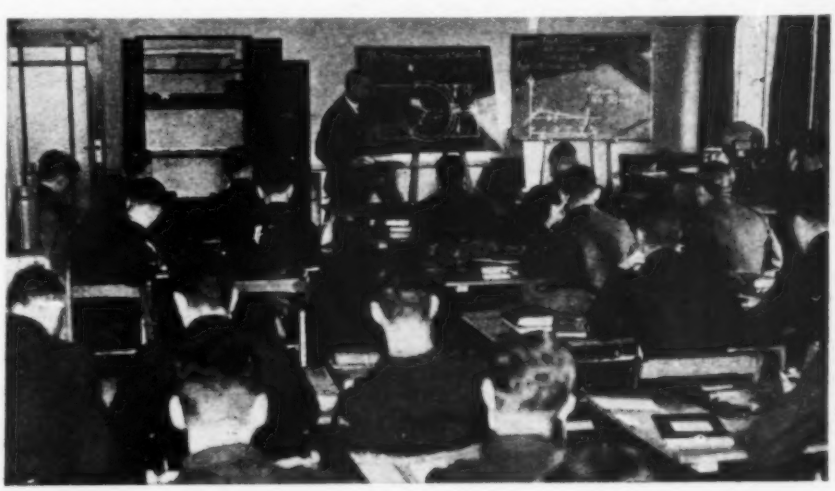
To do all this and to do it well requires thorough and specialised training. Photography, signals, reconnaissance, bombing, gunnery, meteorology—these are the subjects he must study.

I.T.W. to O.T.U.

Air observers under training arrive at the Air Observers Navigation School from an Initial Training Wing where they have had elementary ground instruction with pupil pilots, in navigations, signals and maps. During their course at the A.O.N.S. they do a considerable number of hours' flying (censorship regulations do not allow the precise number to be stated or the number of weeks taken over the course). This commences with air experience and elementary map reading and ends with long navigational flights over the sea and above cloud. Observers are taught to take complete charge of the navigation and towards the end of the course are "briefed" for all manner of exercises.

During the last week of the course a final examination is held. The standard demanded is high, and failure in any subject makes the pupil liable to suspension. If found unsuitable, consideration is given to putting him to some other work for which his standard of qualification fits him.

From the A.O.N.S. the pupils then pass to a Bombing and Gunnery School, corresponding to the Service Flying Training School for pilots, for the next stage of their train-



CLASSROOM NAVIGATION : The use of the Course and Speed Calculator being explained by an instructor.

WAITING THEIR TURN: While waiting for dual instruction or solo practice in the air, the Y.M.C.A. can be relied upon to provide pupils with a very welcome cup of hot cocoa on a frosty morning.

ing. Then comes "war training," with the pilots, observers, radio operators and air gunners working as a team on the actual types they will use, at an Operational Training Unit.

The Flying School

Pilots also start their Royal Air Force life at an Initial Training Wing just as observers do. At these establishments they do not go into the air but become familiar with the equipment and the jargon relating to it. At this Elementary Flying Training School visited in the Midlands the new term of pupil pilots had just arrived the day before. Two terms are kept going together, seniors and juniors, so that all the trained men do not leave together and a continuity of tradition is established.

One saw the junior class starting work. Some were having a session on the Link Trainer—and how that stubby little fuselage spun with their inexpert handling of the controls! But it was only within the confines of the room that it was spinning. Instruction on the Trainer and in the air in Tiger Moths is carried along together so that the old distinction of flying on the horizon and on the instruments is being lost. No man is a pilot who cannot fly on instruments, and one should be able to use just whatever is appropriate to the occasion, though one can only dispense with a few instrument dials even with the clearest of horizons. Thinking of flying in England reminds one of the story told by the Mesopotamian pilot at tea who one day congratulated his pupil on his luck in having a day with wonderful visibility and a perfect horizon. "Yes," said the pupil, "but what do I do with it?"

At the E.F.T.S. pupils enter as groundlings and leave it (an unspecifiable number of weeks later) as complete masters of an elementary training type, in this case, the Tiger Moth, being able to loop, roll, and roll off the top.

COMPASS SWINGING: Getting the Tiger Moth correctly lined up on the base is the first step in adjusting the compass to ensure that it reads correctly.

R.A.F. INSTRUCTION (CONTINUED)

After Link Trainer work, dual instruction in the air in turns, landings and spins, and ground instruction in parachutes, the pupil goes on his first solo. This is certainly a hurdle, but the clearing of it is not such a nerve-tightening affair as one would expect. And what a warm glow after that first landing has been made! (At this school the average first solo is made at eleven hours.) After making the first circuit and coming in to land it is a very usual fault to overshoot, as the aeroplane is relieved of the instructor's weight and so glides much flatter.

Simultaneously with this flying, classroom theory is being learnt, for pilots fly as much with their heads as their hands in these days of complex technical development. In the classroom and on the aerodrome they are taught airmanship, navigation, meteorology, signals, armament, engines and rigging. Little is given on these last two subjects as it is realised in wartime that for the maintenance of the machine the pilot must depend on ground staff who are fully trained to do their important work. But pilots do enough to understand the problems involved.

New Spin Technique

In the air the pupils master all sorts of turns, including that one most productive of trouble, the gliding turn, out of which, if one will persist in holding off bank, one can spin quite easily. Plenty of spinning practice is given, this being regarded as the most important of the elementary aerobatics, for if a pilot has complete confidence in his spins he feels he is the master of his craft and can make it do what he asks of it. It is an interesting point that the control technique for getting out of a spin has now been slightly altered.

Previously it was to put on opposite rudder and then, about two seconds later, to bring the stick forward. Not too far forward, as this leaves the aeroplane in a steep dive after the spin has been stopped, a decided disadvantage if near the ground. Now it is to put on opposite rudder and stick forward simultaneously, "and with no apologies," as the instructor said. It is permissible to put the stick right forward, although this is not necessary on a Tiger Moth. The reason for the change seems to be that the procedure is necessary with some of the advanced trainer types, the North American Harvard, for example, and so it is taught right from the start. A Tiger Moth loses about 300ft. per turn in a spin, but a Harvard between two and three times that height. A safe height for a spin in a Harvard is to start at 9,000ft.

Though enormous numbers of men have volunteered for the Royal Air Force, still more are required to keep a steady flow of trainees always going through the course. Volunteers, who must be between the ages of 18 and 33, should apply to the R.A.F. Section of their nearest Recruiting Centre.

HERE and THERE

FROM CALIFORNIA TO THE BATTLEFIELD: One of the Douglas DB-7As, the improved Boston, does a test flight over Santa Monica before leaving for England.

Belgian Pilots' "Bag"

MANY Belgians now in England are training to become R.A.F. pilots. Already their compatriots now serving in the R.A.F. have accounted for some 20 enemy aircraft since the invasion of their country drove them to England.

Youngest Solo?

BOB MARTIN, 12-year-old Toronto boy, flew solo on November 9. He is believed to be the youngest to do so on the North American Continent, perhaps in the world. He has been taking instruction for some time, and, after a perfect landing with his instructor, was told to take off. He made two circuits, and landed successfully.

With R.A.F. Compliments

THE R.A.F. have given the Greek Navy a useful Christmas box in the form of an Italian destroyer which they "purchased" at the price of a few well-placed bombs at Santa Quaranta. One imagines that the Greeks thought none the less of their present because it needed a few repairs before being recommissioned, for a plaque on the destroyer's bridge bears the inscription, "Presented to the Greek Navy by the Royal Air Force."

Pukka Sahibs Lend a Hand

A PRIVATE aircraft factory which is to be established in India has received initial help from the Government of that country. According to a message from Delhi, the firm was helped in securing a site and also in obtaining necessary plant and raw material from America.

The factory will be established with American technical assistance, and the Government of India has already contracted to buy its output.

Parachutes in Canada

PARACHUTES are being made in Canada at the rate of 500 weekly, it has been announced. Two companies, Irvin Air Chute, Ltd., and Switlik Canadian Parachute, Ltd., are making practically the entire Canadian output, with the exception of housings and a few other small fittings. Approximately 13,000 parachutes have been ordered since declaration of war, with about 4,800 delivered. No shortage of materials has been encountered, but research is being carried on with a view to development of alternative sources of supply and of substitute materials. The majority of parachutes ordered for the Royal Canadian Air Force are of the 24-foot Service type, although some 28-foot training parachutes have been bought.

Sir Philip Joubert

NEWS that Air Marshal Sir Philip Joubert has been compelled, through pressure of more important work as Assistant Chief of Air Staff, to postpone for a time his broadcasts on air topics will have caused a real sense of disappointment and regret to many thousands of listeners. But there is comfort in the hope that this deservedly popular series of talks may be resumed at a "not far distant" date.

Right from the start, Sir Philip's pleasantly informal chats on the wireless earned for him a universal appreciation. Many aspects of the war in the air which were a mystery to the greater proportion of the British public were explained by him in a simple, straightforward manner that could easily be understood by all, and he had a flair for selecting just those points which "the man in the street" most wanted to hear about.

By virtue of his rank and position Sir Philip was able to invest all he said with an authenticity that inspired complete confidence and, moreover, he had a pleasing delivery which may, perhaps, best be described by saying he was always "easy to listen to." We shall all look forward to his promised return to the microphone.

Per Film-star ad Astra

BRITISH film-star Laurence Olivier, who has been learning to fly while in Hollywood and has 140 hours in his log-book, is now on his way back to England intent, it is reported, on joining the R.A.F. Should he be accepted for service he might conceivably get together with Ralph Richardson, who has been in the R.A.F. for some time, in forming the nucleus of a Film-star Squadron!

The Real Thing

AERIAL film dramas which include scenes of mid-air combat have been produced on a number of occasions—"Hell's Angels" and "Dawn Patrol" were, perhaps, two of the most notable—and they never fail to thrill schoolboys of all ages from seven to seventy. But they were, at best, only fiction and one could let one's imagination supply the excitement with the comfortable inner-knowledge that nobody was really being shot down in flames. The Ministry of Information's film, "Fighter Pilot," which was recently released, however, brings the grimness of aerial combat home to the watcher with stark realism. It includes "shots" taken by the cameras fitted alongside the wing-mounted Brownings of Hurricanes and Spitfires which come into action simultaneously when the pilot presses his gun-trigger.

Atmospheric conditions and vibration inevitably mar the purely photographic quality of these scenes, but this only serves to emphasise their authenticity, so that when one sees pieces fly off the wings or tail of the Nazi machine and smoke pour from one of its engines as it heels over to begin its fatal plunge, one experiences the grim satisfaction of witnessing the photographic record of an actuality.

Canadian Trainers

DELIVERIES of 808 single-engined Fleet and de Havilland trainers will be completed by end of January, 1941, 15 months ahead of schedule, according to an announcement of Munitions and Supply Minister C. D. Howe on November 25 at Ottawa. Contracts originally called for delivery of 16 aircraft monthly from each of the plants, with production to take 25 months from date of the first delivery, April 10, 1940. Mr. Howe said that 575 trainers had already been delivered. After January both companies will devote their entire facilities to the manufacture of other types of aircraft.

R.C.A.F. Staff Reorganised

A REORGANISATION of the Royal Canadian Air Force headquarters was announced on November 20 by Air Minister C. G. Power. This is a move to decentralise administration of the British Commonwealth Air Training Plan. The change creates a new post of Deputy Chief of the Air Staff, adds two new divisions to headquarters at Ottawa and necessitates two additional members of the Air Council, for training and supply The Air Council under the new arrangement consists of Air Minister Power, president; James S. Duncan, deputy minister, vice-president; Air V-M. L. S. Breadner, chief of air staff; Air Comdre. G. O. Johnson, deputy chief of air staff; Air Comdre. A. A. L. Cuffe, member for air staff; Air Comdre. Robert Leckie, member for air training; Air Comdre. H. Edwards, member for personnel; Air V-M. E. W. Stedman, member for aeronautical engineering; and Group Capt. S. G. Tackaberry, member for supply.

THE SLIP-WING FIGHTER

A Startling Proposal : Composite Standing Patrol : Application to Existing Fighters

By NOEL PEMBERTON-BILLING

(*Continued from page 525*)

Last week Mr. Pemberton-Billing dealt with the slip-wing fighter, mainly as regards its speed relative to the slip-wing bomber. In this article he argues in favour of the type for standing patrol work at night, using a standard Hurricane as the fighter.

A MORE important application of the slip-wing is to the problem of bringing down the night bomber, surely the most vital problem of any at the moment. Although the very meagre figures of night raiders shot down do not make any distinction as to how many are due to the ground defences and how many to the fighters, it is fairly certain that most of them are due to fighter action on moonlit nights.

The use of fighters at night is limited by the suitability of the weather conditions, the duration of their fuel supply, the danger of illuminating aerodromes at night, and the difficulties of finding enemy bombers in the darkness.

All four of the fighter types at present in service with the R.A.F. are, or have been, used at night. The single-engined single-seaters, the Spitfire and the Hurricane have the high speed necessary to give them a reasonable chance of overtaking enemy bombers, but there are other limitations which have prevented their very extensive use. The small petrol load, which is essential to their high performance, limits their endurance to about two hours. This fact, when one subtracts the time in taking-off and gaining height and in returning to land, does not allow of a very long patrol. This short endurance has the additional disadvantage of requiring more frequent illuminations of the aerodrome. Their comparatively high wing loading must make them fairly difficult to land at night.

The Two-seater Fighter

The Boulton Paul Defiant two-seater fighter, although it must presumably have an even higher wing-loading than the single-seaters, as, despite its greater weight, it does not appear to have any more wing area, is more extensively used for night-fighting. Presumably this is because it can carry fuel for a longer period in the air. Its heavy armament makes it a very effective weapon when it does make contact with the enemy.

To overcome the disadvantage of short duration, which must apply to all these small types, the Bristol Blenheim medium bomber, in both its long- and short-nose versions, has been modified for use as a fighter, and considerable numbers of these machines have been put into service. Although they certainly possess the ability to carry a large fuel load, and can also carry a crew of three and heavy armament, they do so only at the expense of speed. The top speed is 279 m.p.h. and somewhat increased in the newer versions. Even this later figure is only slightly greater than that of some enemy bombers and slightly below that of others. This means that it must always have an advantage in altitude or position before it can make an attack, and cannot hope to overtake the enemy once he is past, except in the case of some of the older and slower German types such as the Ju. 86 and Ju. 90, or the necessarily slower marine types such as the D.O.18 and the He.115, which do not so frequently approach our shores nowadays.

The fighter has proved itself to be the only effective defence against the night raider, and it is only by increasing the ability of the night fighter to remain in the air and to find and overtake the raider that we can hope to take any toll of the enemy's bombers.

For patrol work the ideal is a comparatively large aeroplane with large, lightly-loaded wing to provide economical cruising. It should carry a crew of two, together with fuel for from four to eight hours' patrol. For the actual fighting, a small, fast single-seater is necessary to overtake and out-manœuvre the enemy.

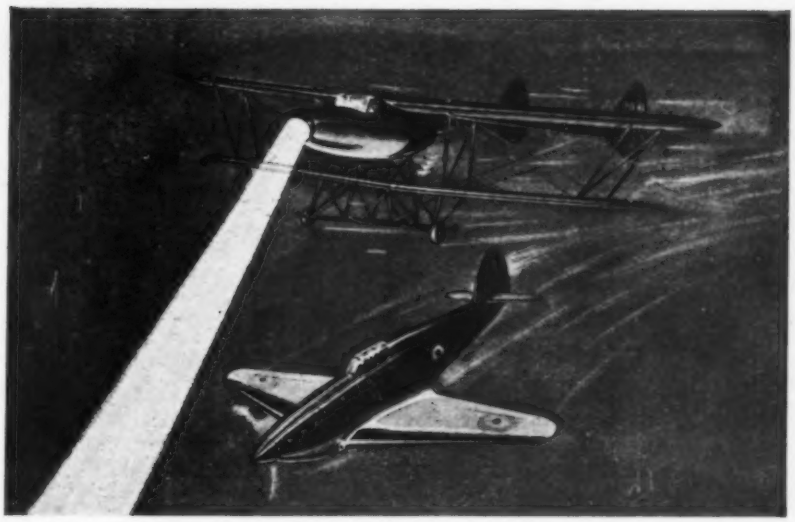
To effect in one design a compromise between these two so very widely differing in requirements is an almost impossible task unless the problem can be approached from an entirely new angle. The differences required in wing area and wing loading might at first suggest the use of some sort of variable area wing, but methods such as telescopic wings, besides being mechanically difficult if not impossible, do not provide sufficient variation of the wing area to be worth their weight.

Further thought along these lines finally led me to the solution of the Slip-wing Fighter. It consists of two components. One is a single-seater fighter of normal type, such as a Spitfire or a Hurricane, or a new type of the same approximate dimensions. The other is of entirely different type, being more of a power-glider than an aeroplane. It has a large wing and very low wing loading. It is provided with a light Gipsy engine, and carries a crew of two, together with flares, and a searchlight if required.

This machine forms the upper component of the com-

An artist's impression of how the Pemberton-Billing composite patrol fighter would look when taking off.

THE SLIP-WING FIGHTER (CONTINUED)



The slip-wing fighter has been cast off, and the upper component has switched on its searchlight to show up the enemy bomber.

bination, and would be built in the form of a strut-braced, high-wing monoplane with the engine arranged as a pusher. The two pilots would be in the nose, where one of them can operate a gymbal-mounted searchlight. This upper machine also carries radio equipment and large tanks of petrol and oxygen from which the fighter is fed whilst on patrol.

The upper component has a steel skid structure which saddles over the fuselage of the fighter, and is attached to the top main longerons at four places coupled to a release gear. The two components thus form a biplane for take-off and whilst on patrol. Considered as a composite aeroplane, this forms the ideal type for patrol work. The large wing of the upper component reduces the wing loading to a fairly low figure, and thus enables an economical cruising performance to be obtained. It has a total crew of three, enabling the patrol flying to be carried out in turns by the crew of the upper component, whilst the pilot of the lower machine can be resting, or even asleep.

Economical Cruising

For normal patrol work, the engine of the lower machine is used, running at less than half throttle, 300 h.p. being sufficient to keep the lightly loaded combination afloat, even at great altitudes.

When warning is received of the approach of enemy aircraft the fighter opens up his engine; the engine of the upper component, which its airscrew has kept turning over, is started also. The pilot then presses the control knob which releases him from the upper component and goes into action as a fighter. He already has his height and a warm engine, together with full tanks for two hours' duration or more, and is feeling quite fresh, as he has been resting during all the period of the patrol.

Meanwhile the upper component can also assist. Now that it has released the fighter, it becomes very lightly loaded. If it is equipped with a searchlight it can use this to pick out the enemy bombers for the fighter. If the bombers are accompanied by their own defending fighters the slip-wing may be in danger of being attacked, as the light would make it easy to find, but it is not usual for bombers to be accompanied by fighters at night. Also the lightness of the upper component should enable it, if it has a sufficiently powerful engine, to outclimb enemy machines, and if necessary seek refuge at an altitude greater than they can reach. It might in any case pay to fit the slip-wing with a fairly powerful motor, so that it can fly at a speed somewhere near that of the enemy bombers and so keep them in the beam of its light indefinitely.

As an alternative to the searchlight, it can carry parachute flares to illuminate the enemy. Here, again, the ability to fly as fast as the enemy bombers would be of advantage on very dark nights, when it is possible that if the fighters did not succeeed in shooting down the enemy before he was out of the illuminated area they might lose him in the darkness.

If the upper component has only a light engine it will be necessary, when cruising as a combination, to use the fighter's engine, running at about 33 per cent. throttle, to supply the power, but if, for the purpose of giving it more speed, the upper machine is fitted with a more powerful motor, then the cruising could be done on this engine, the engine of the fighter being sealed and run-up at regular intervals to keep it warm. Possibly, if an exhaust lifter were provided to allow the airscrew to windmill fairly fast, this might keep the engine sufficiently warm.

Fitting the upper component with more power would increase its weight considerably, and thus increase the load on the undercarriage of the fighter for taking off, so that if it were intended to use an existing type for this purpose the total weight might become too great. If the weight of the upper component can be kept to within 3,000 lb., as it most certainly should, it should be quite safe for a normal fighter to take off with this amount of additional load on its undercarriage. The fighters themselves weigh about 6,000 lb., so that the load factor of 4 on the undercarriage will be reduced to about 3, but as the loads incurred in take-off are never likely to be as great as those in landing, this factor should be quite sufficient. For landing the two components are, of course, separated. Once the fighter is released from the upper component, its duties are exactly those of a normal fighter, so that there are no tactical reasons why a standard fighter should not be adopted. The fact that it already possesses its altitude and position before it begins to use its own fuel supply would enable a new type, specially built for this purpose, to be smaller and faster than existing single-seaters. It would be possible to design a special slip-wing fighter with Merlin engine capable of over 400 m.p.h.

Existing Fighters Used

But the job could be done quite effectively by the Spitfire or Hurricane, and it is only purely practical considerations, particularly in the arrangements for attaching the slip-wing, that any difficulties are met with. The fuselage of the Spitfire is of duralumin stressed-skin construction. This would not be very suitable for taking the concentrated loads. It probably would not, therefore, be possible to utilise the Spitfire for this purpose without considerable modification.

The Hurricane, however, is far more suitable. Its

THE SLIP-WING FIGHTER (CONTINUED)

fuselage is built up on the traditional Hawker method of a riveted steel tube framework, with a light fairing added to form the external shape. This type of structure is far better suited to taking concentrated loads, and I believe that it would be possible to adapt this type for the job with very little modification.

The early production models of the Hurricane had eight machine guns, a maximum speed of 336 m.p.h. at 7,500ft., and two hours' duration. On later models more power and heavier armament have increased both speed and fire power, so that, although it made its first appearance in 1933, the Hurricane is still a first-rate fighting machine, superior to anything that the enemy have yet produced.

It would require very little time and material to borrow a Hurricane (an early prototype could be used if necessary) and build for it a simple wooden "slip-wing" with a 200 h.p. Gipsy engine. It would then be possible to make a fair trial of the scheme, and nothing short of the failure of this trial will satisfy me that it does not provide an effective defence against the night bomber. If I am proved to be wrong, then I have lost a few hundred pounds and the Government has lost a little material it has allowed me to buy. If it proves the success that tactical experience and design calculations prove that it should, then is not such a defence worth the risk of so small an outlay? Apparently the Air Ministry consider that it is not.

THE TWO-STROKE DIESEL ENGINE (Continued from page 545)

cylinders per unit cylinder volume, the lower the weight. This, taken to its logical conclusion, would mean a single cylinder unit, which was absurd.

MR. JOHN NEILL remarked that the author suggested that the Junkers Jumo oil aero engine was in advance of anything in this country. It was interesting to note that the first German bomber brought down near Edinburgh was fitted with a Junkers Jumo using petrol.

MR. A. ORTON was sure the author was on the right lines, and drew attention to the Kadenacy two-stroke system. Engines of this type with a b.m.e.p. of 142 lb. per sq. in. and 1,500 r.p.m. were working regularly without the use of any air pump. With air under a moderate pressure, 200 lb. per sq. in. had been obtained. He was doubtful of the proposed increase in cylinder size and reduced r.p.m. compared with present aero-engine practice. He thought it would lead to a decrease in b.h.p. per litre and b.h.p. per unit weight.

MR. S. CAMM fully supported the case made out for the need for an intensive programme of research and development to produce a successful C.I. two-stroke engine. He agreed with the size of the proposed engine, thought its proposed form excellent, though it would be a great advantage if it could be made even shallower. He fully supported indirect cooling and felt that this would be the ultimate method. He thought the proposed oil cooler was inadequate, and suggested that a ducted cooling system as used on present aircraft was probably best.

MR. A. GOUGE also thought the author had put forward an extremely good case for the C.I. engine, and that research on it should be actively pursued. The consumption of the modern petrol engine was in the neighbourhood of 0.42 lb./b.h.p./hr. while that of the contemporary C.I. engine was now about 0.38 lb./b.h.p./hr. Allowing for increased weight of the latter, the gain in range appeared small.

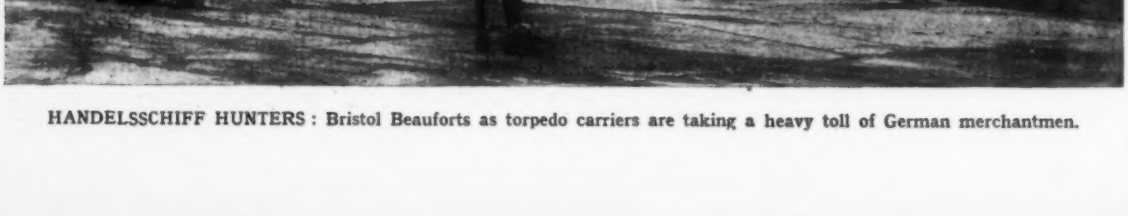
With high wing loadings, take-off was extremely important. Did the author see the possibility of increase in take-off power from the C.I. engine, such as was possible with the petrol engine?

He thought the proposal to instal the engine completely within the wing would prove extremely difficult. Pusher airscrews had their disadvantage, perhaps the most serious of which was a loss in the case of four-engined aircraft of approximately 15-30 per cent. of lift at take-off.

DR. F. W. LANCHESTER completely disagreed with the author's dictum that the fewer and larger the cylinders (within definite limits) per unit total cylinder volume, the lower the weight per horse power. But Dr. Lanchester did believe that the diesel would win part of the field, at any rate, in the long run, and that the two-stroke was inevitable.

Conclusions to be drawn from the full and lively discussion were that on the whole there was a general agreement that the two-stroke diesel deserved more intensive research, but the author had underestimated the mechanical and other difficulties to be overcome before a successful result could be obtained.

As the author is building the engine he advocates, it is to be hoped that the medicine he will have to take on the way will not be so nasty as many of the speakers in the debate suggested it would be.



HANDELSSCHIFF HUNTERS: Bristol Beauforts as torpedo carriers are taking a heavy toll of German merchantmen.

FLOTATION OF AEROPLANES

A Simple and Rapid Method of Obtaining the Flotation Attitude

By J. A. MEDHURST, A.F.R.Ae.S. (of Short Bros. (Rochester) Technical Staff)

ONE of the problems with which the aeroplane designer has to deal is that of forced landings at sea. It is obvious that when a landplane is compelled to alight on water, it should float at least long enough to enable the passengers and crew to stand a reasonable chance of being rescued, or to make a safe escape using any marine equipment provided for the purpose. To ensure this it is necessary for the aircraft not only to have a fair margin of reserve buoyancy, but also that the flotation attitude should be such that personnel will not be in danger of being trapped and that egress is unobstructed. The reserve buoyancy should be at least 40 per cent., and it may be found necessary to provide some emergency flotation gear, or to modify parts of the structure to obtain additional watertight compartments, in order to make up for any deficiency. The designer should therefore determine in the design stage to what extent the aeroplane is buoyant, and the water line at which it will float, so that the structure may incorporate the minimum watertightness.

The computation of the reserve buoyancy is comparatively easy, but the determination of the flotation attitude presents greater difficulty. Considering each in turn the procedure is:—

Calculate the buoyancy of each component part of the aeroplane, i.e., main plane, tail unit, power unit, main and tail undercarriages, fuel and oil tanks, structure, equipment, etc. By the summation of these obtain the total buoyancy, Δ, of the aircraft under forced landing conditions.

If W=all-up weight of machine on landing (i.e., after jettisoning everything that should be disposed of in such an eventuality), then:—

$$\text{Reserve Buoyancy} = \left(\frac{\Delta}{W} - 1.0\right) \times 100.$$

The accepted method is by calculation, but as explained below this is not very satisfactory, as in practice it becomes more of the nature of an heroic estimate. Alternative methods will therefore also be considered:—

(*a*) *By Calculation*:—Knowing the reserve buoyancy, an intelligent guess at the position of the waterline can be made. Calculate the displacement of the portion submerged and its centre of buoyancy. In accordance with the elementary laws of hydrodynamics, the weight of water displaced must, of course, equal the all-up weight of the aeroplane, and the centre of buoyancy must lie on a line dropped from the centre of gravity perpendicular to the waterline. If these conditions are not fulfilled, the assumed waterline must be adjusted and the process repeated until the correct waterline is obtained.

In the case of an aeroplane with a completely watertight exterior a few approximations only should be necessary, but for an aeroplane with a fuselage, wings, and tail unit non-watertight to some extent, the process becomes prohibitive since the buoyancy of all parts of the structure and equipment below the waterline have to be calculated and corrected at each successive approximation.

(*b*) *By a True-to-scale Model*:—The obvious alternative is to employ a true-to-scale model, but since this involves an accurate representation of the aeroplane complete in every detail, including structural detail and equipment, it will be appreciated that this is entirely impracticable. However, by representing each component part of the aircraft by a simple shape of equivalent buoyancy, a schematic model can very quickly be produced, the flotation attitude of which will approximate very closely to that of the full-scale aeroplane.

(*c*) *By Buoyancy Model*:—So far as the writer is aware, this method was first employed at Short Brothers. The manner of constructing a "buoyancy model" and the procedure to obtain the waterline are outlined below.

Calculate the buoyancy and position of centre of buoyancy for each of the components of the aeroplane, and prepare wooden blocks of corresponding buoyancies. If B=buoyancy of component, and the linear scale of buoyancy model is $1/n$, then the buoyancy of wooden block $= \frac{B}{n^3}$. A specific example will serve to make the method clear. For a certain aircraft numerical values are:—

Weight of engine complete with airscrew hub, exhaust system and accessories=1,974 lb.

Taking the mean specific gravity as 5.25,

$$\text{Buoyancy of engine} = \frac{1{,}974}{5.25} = 376 \text{ lb.}$$

$$\text{Volume displaced in water of density 64 lb. per cu. ft.} = \frac{376}{64} = 5.875 \text{ cu. ft.}$$

Using a model of linear scale $\frac{1}{2}$in. to 1ft., i.e., $\frac{1}{24}$ full size,

$$\text{Buoyancy of model} = \frac{5.875}{24^3} \text{ cu. ft.} = 0.7344 \text{ cu. in.}$$

The most convenient form for the model is a cube, the length of the side of which will be $\sqrt[3]{0.7344} = 0.902$in.

The position of the centre of buoyancy measured perpendicular and parallel to the horizontal datum line for the aircraft is 9.6ft. forward and 0.98ft. above the centre of gravity of the machine, for which the corresponding model dimensions will be 4.8in. and 0.49in. respectively.

Obtain a rectangular sheet of plywood and attach a supporting spindle through the centre of area. This represents the C.G. of the aeroplane. From it draw two lines at right angles, these lines being considered as parallel and perpendicular to the horizontal datum line of the aircraft. Immerse the ply sheet in water and add lead weights around the spindle until the sheet remains in any position in which it is put under the water and does not tend to sink or rise to the surface. Hence the sheet now has a mean specific gravity of 1.0, its centre of buoyancy coincides with the C.G., and when totally submerged it will have no effect on the buoyancy of the model for which it serves as a base.

On the base sheet mark off the positions of the centres of buoyancy of the components relative to the C.G., and attach the wooden blocks to the sheet such that the centre of buoyancy of each block is coincident with the corresponding position indicated on the base sheet. The model thus formed should then be balanced about the spindle, since this represents the C.G. of the aeroplane and must therefore be made the C.G. of the model.

With the base sheet in a vertical plane, lower the model into a tank of water.

If W=all-up weight of aeroplanes on landing, the corresponding model displacement must be $\frac{W}{n^3}$ lb. In all probability the actual weight of the model, w, will be in excess of this, hence it will be necessary to support the model by balance weights $= \left(w - \frac{W}{n^3}\right)$ lb.

The waterline obtained is only a first approximation, as it will be found that, since the ply base is not totally submerged, it is affecting the flotation attitude. The positions of some of the lead weights used for balancing for correct C.G. may also be such that their buoyancies are entering into the result. It will be necessary to alter the shape of the ply base, and possibly to house some of the lead balance weights. By a process of trial and error it is not difficult to obtain a waterline that is dependent on the wood blocks only. This waterline corresponds to that at which the full-scale aeroplane will float.

TWELFTH OF NOVEMBER, 1940

A vivid impression of the great torpedo attack by Swordfish of the Fleet Air Arm on the Italian warships in Taranto Harbour.

CORRESPONDENCE

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

INVISIBLE VORTICES

Black and White

THE dark trail witnessed by your correspondent would be caused by the aircraft churning its way through cirro-cumulus or cirro-stratus cloud and making a tunnel through the ice particles. It occurs also when aircraft pass through lower clouds composed of water vapour, but, in this case, the tunnel fills in too quickly for ground observation to be made.

Such a trail can be made by an aircraft whether it had previously been making a visible vortex or otherwise. It is by no means a phenomenon and may be compared to the swift passage of fish through muddy water.

In East Kent we have had several opportunities of observing the formation of dark trails, mainly when there has been cirro-stratus cloud present and the sky has had a murkiness usually preceding a deterioration in the weather. H. NICHOLSON.

BUTANE AS A FUEL

No Advantage Over 100-octane Petrol

THE use of butane as a fuel for aircraft, as suggested by Mr. John W. Morrison, is not a new idea. Exhaustive tests were carried out on liquid butane several years ago, but any advantages over higher boiling point fuels have now disappeared since 100-octane petrols became available. The calorific values and air fuel ratios of n-butane and iso-butane are very similar to the values for an average 100-octane petrol. Iso-butane has an octane rating of 100; n-butane is rated at 90. The remaining advantage of weight is quite substantial but is partly nullified by the special lagged tanks which are necessary to prevent excessive evaporation of the fuel when the engines are not running. (B.P. for n-butane is −0.6 to −0.3° C.; B.P. for iso-butane is −10.2° C.)

The fuel consumption of 0.38 lb./b.h.p./hr. given for neohexane would only be within the reach of a single-cylinder research unit with a higher compression ratio than standard. No modern aero-engine could give such an economical setting even on 100-octane fuel, and neohexane is rated at 94 octane. 0.275 lb./b.h.p./hr. on butane sounds even less likely.

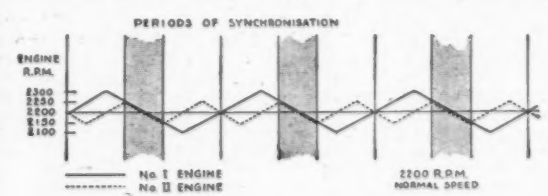
Butane is not available in any quantity in this country but methane (marsh gas) has already been suggested as a wartime fuel for automobiles. C. CAMPBELL, M.Sc.

NOISE PRODUCED BY UNSILENCED AEROPLANES

A Question of Synchronisation

I HAVE read with interest Mr. Campbell's article in *Flight* on the identification of aircraft by sound, and would like to record certain observations I have noticed that there are planes emitting a note of steady pitch and those emitting a fluctuating note. Single-engined planes emit a sound more or less steady in pitch, while two- and multi-engined planes are generally distinguished by a fluctuating note, rising and falling in intensity. This phenomenon is due to a slight variation, i.e., alternate increase and decrease of the engine's speed which, although not noticeable in a single engine, synchronises periodically with the speed of a second or other engine, causing a more intense sounding of the note when the point of synchronisation is reached and falling off again as the synchronising speed is passed, as shown in the attached rough sketch. The points where the curves of each engine intersect are the periods of synchronisation, and therefore of maximum sound.

The sounds emitted by two single-engined planes flying closely together is very similar to a twin-engined plane, and it can be said that at a height of 15,000ft. to 20,000ft. and over the only sound heard on the ground is the engine exhausts. A plane falling from a great height without its engine firing is inaudible until it reaches an altitude of about 10,000ft., and then a whistling note is apparent which increases in intensity until the machine hits the ground.



Should it be desirable to eliminate the fluctuating sound of multi-engined planes, this might be done by electrically synchronising the ignition devices.

I trust these few remarks will prove helpful to those interested in this subject. REX DAINTY,

Capt., R.A.F., R.N., Technical Dept., Air Ministry (Ret.).

HABIT AND HIGH FLYING

A Septuagenarian's Experiences

MR. PEMBERTON-BILLING tells us that "provided he is not required to do anything energetic, a man can continue to breathe without any additional oxygen up to a height of about 15,000 feet."

It is, in fact, largely a question of individual physique and habit. Thus mountaineers, including the writer, can climb rocks easily unaided at this height. And I may add that during Alpine wanderings as a pilot I used to fly with comfort and enjoyment at 15-18,000 feet, aware only of the charm of the splendid outlook. But then these wanderings were part of my daily life.

Clearly, up to a point, habit secures adjustment in the robust of good lung capacity. Similarly, adjustment can be secured in another respect. Beginning to fly late in life, I noticed troublesome murmurs, lasting 2-3 hours, on descending from quite modest levels. These aural disturbances ceased later, giving place to the passing phenomena stopped by pinching the nose and swallowing. The organism had learnt its lesson.

"A PILOT OF 74."

P.S.—On descending after a long journey at great height it is well to land carefully, circling fully the aerodrome. Habit has been interfered with and visual judgment may be impaired.

THE "SLIP-WING" SCHEME

Independent Check on Performance

IT is now four weeks since the first of Mr. Pemberton-Billing's articles on his slip-wing aircraft appeared, and so far there has been no criticism which cannot be answered.

The weight estimate appears to be reasonable. The apparently low weight of the tricycle undercarriage can probably be explained by the fact that the largest load factors occur during landing, when the aircraft is comparatively light. In any case, the errors in the weight estimate are not large enough to have much effect on the enormous disposable load which the aircraft could carry.

The performance estimate also seems to be sound. In an independent check of the performance, I have obtained top speeds within 3 per cent. and horse-powers required for cruising at various all-up weights within 10 per cent. of those quoted in the article.

No doubts have been expressed about the method of assisted take-off. The method is very similar to that of the Mayo composite aircraft, except that the separation should be easier, owing to the powerful separating force which exists at all speeds. Also the upper component of the P.B. aircraft is much less costly than the Short *Maia*.

It is quite possible that some trouble will be experienced with controls at first, but few high-speed aircraft have perfect controls on the first flight. Undue heaviness of the controls at high speed could be reduced by the use of servo-tabs on the control surfaces, but if sufficient control cannot be obtained by this means, the use of hydraulic servos in the control circuits should overcome the difficulty. It should be remembered that during take-off and climb to operational height the controls of both components can be used, and that after separation a high degree of manœuvrability is not required.

Several correspondents have criticised the slip-wing bomber on the grounds that it could be shot down by slip-wing fighters. When it is realised that most long-distance bombing is done at night, and that the night-bomber is practically immune from attack by fighters, this sort of criticism seems rather futile.

The only real fault of the P.B. bomber is that it is not approved by the Air Ministry. No doubt the technicians of the Air Ministry, in their wisdom, can prove conclusively that the slip-wing scheme will not work. After all, they proved the same of V.P. airscrews, retractable undercarriages, split

CORRESPONDENCE (CONTINUED)

flaps and long-chord cowlings. In the same way the Admiralty of the last war was convinced that the convoying of merchant ships was unsound, and when public opinion at last forced the adoption of the convoy system, there was only two weeks' supply of food in this country.

Let us hope that public opinion will rouse the Air Ministry into action, before large numbers of slip-wing bombers bearing the Swastika appear over our towns and prove the soundness of the scheme in a most unpleasant way.

L. G. MORRIS, B.Sc. (ENG.).

SPEED OR ARMAMENT?

An Analogy

WITH reference to Mr. Jackson's letter, "Speed or Armament?" I should like to draw an analogy between the bomber protection problem and that faced by the weaker animals of a forest in which there lives a beast of prey.

First, let us take the rabbit, who relies on his speed to make good his escape, but is sometimes caught napping and at others is not fast enough. The "P.-B." bomber corresponds to the rabbit. Secondly, the porcupine, whose prickly nature makes him an unpopular object for attack, but who could hardly hope to withstand a determined onslaught. The porcupine corresponds to one of our modern bombers. Lastly, there is the tortoise, who is far too dignified to engage in a vulgar brawl. On the approach of danger he retires into his shell, in which he is perfectly secure against all attack. There is no armoured aircraft as a counterpart to the tortoise, but there is surely much to be said for it.

The business of a bomber is to locate its target, drop its bombs there, and return home safely. The speed with which it can carry out this operation is immaterial, and I feel that too much attention is paid to this clay-footed deity which is for ever being appeased with sacrifices of disposable load.

I visualise an aircraft with a cruising speed no greater than its speed of take-off. This would give it a maximum lift/drag ratio and enable it to carry a much greater load than a similar aircraft with a wide speed range. It would have no gun positions to spoil the streamlining of the fuselage, and all vital parts would be armoured to withstand the direct impact of a 40 mm. cannon shell. The structure would be built more sturdily than in the present bombers, so that only a direct hit from an A.A. shell would be likely to result in her destruction. I have insufficient experience of aircraft to work out the proportion of the total weight which would be taken up by the armour and structural stiffening, but I feel that the disposable load of a large aircraft built on this principle would still be very much greater than that of the present bombers with the same horsepower.

In conclusion, may I add my voice (small though it may be) to the sentiments expressed in Mr. Jackson's last paragraph? It is far easier to make the powers-that-be accept a *fait accompli* than a theory.

T. R. U. CROKER.

SUB-CONTRACT DRAWINGS

Production Problems in the Design Stage

I FULLY endorse "Reamer's" comments on "Design and Production."

Coming to aircraft from the automobile industry, I am very surprised to see what scant attention is paid to possible production problems in the design stage of a project, and this, coupled with lack of knowledge or experience on the draughtsman's part, will keep down production and put cost up.

These days designs tend to be approved and put into production almost before detailing is completed, so that any attempt at a later date to improve the design for ease of production, and production by outside firms, will most likely involve the scrapping of non-standard gauges, tools, jigs and fixtures which have been made on the basis of the original design, and also start an endless stream of "mods" which will in turn hold up the D.O. programme.

To my mind, planning for production should start in the design office, or alternatively, if the design staff cannot cope with production requirements, the organisation should be such that it includes a department that will watch over production interests *before* actual production is commenced upon.

Many man-hours can be thrown away in the design office by indifference to, or inability to appreciate, points affecting production, and as many more in the detailing stage due to lack of proper supervision and intelligent thinking.

"OBSERVER."

BOOK REVIEWS

How We Find Out, by Professor A. M. Low. 5s. Nelson.

READERS of *Flight* need no introduction to Professor A. M. Low, whose writings on a wide range of scientific subjects have always brought to bear a clarity of expression which makes even the most complicated matter delightfully easy to follow. In his latest book, *How We Find Out*, Professor Low has outlined the progress of man's scientific knowledge and the process by which it has been and still is being achieved. While in no sense does he "talk down" to the non-scientifically minded, his book does not demand that the reader shall possess scientific knowledge in order to understand it. You may, for example, know nothing and have cared less about the astronomer's giant telescope, but you can hardly fail to be interested in Professor Low's account of its development, its characteristics and its uses. In conclusion he points out that science is still an embryo, that we cannot yet even cure a common cold, and that "there will come a time when the finest aeroplanes which we have to-day seem little better than the collection of sticks, canvas and string which represented our first attempts to fly."

Squadrons Up! by Noel Monks. 12s. 6d. Gollancz.

MR. MONKS'S book is the first to be written about the Royal Air Force in France during the winter of 1939-40. It is about the two fighter squadrons of the Advanced Air Striking Force and though there is sufficient material in this to make more than one book it must not be thought that this makes up the activities of the whole R.A.F. in France. For there was also the Air Component attached to the Army. As *Daily Mail* war correspondent, Mr. Monks was close enough to the fighting to have seen many intimate glimpses of the life of a fighter pilot and of these he tells. Very descriptive accounts of the air battles are given and of the pilots in them—which many people wish to read of but which the R.A.F. rather deplores. Quite rightly, no doubt, in case it should lead to the "lionisation" of a few men when, as everyone knows, the whole team share in the work and the danger. Fighter pilots sometimes tend to get more of the limelight than the reconnaissance and bomber crews.

There is an illuminating incident about the collapse of France, showing how that unfortunate nation was sold from the top:

> "That very night we got an inkling that the French were going to pack up, though that was not to happen for two weeks. One of our bomber squadrons operating from a French aerodrome near Blois was ordered to bomb Turin, in Italy. Half an hour before the bombers were due to start, the R.A.F. officer commanding asked the French O.C. to switch the boundary lights on for a few minutes while our bombers took off. The French O.C. apologised and said that his orders were that Italy was not to be bombed."

His escape from France is a vivid picture:

> "France was collapsing about my ears as I walked, hitch-hiked, cycled, taxied, entrained and finally arrived at Biarritz. . . . The Spanish frontier was an hour's drive away, but I could not go in there, because once, during the Spanish War of 1936-39, I had dared to write that I had seen forty Nazi bombers destroy the Basque town of Guernica, and with it 1,000 men, women and children. I am wondering to-day where the English apologists are who rushed into print and declared that the Germans did no such thing. As if they would! The "Reds" did it, of course!"

An interesting book about one phase of the present war.—B. McA. F.

The R.A.F. in Action. 7s. 6d. Messrs. A. and C. Black, Ltd.

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SERVICE AVIATION

Royal Air Force and Fleet Air Arm News and Announcements

U.S. Navy Blimps

FOR training and patrol purposes the U.S. Navy have ordered six non-rigid airships from the Goodyear Aircraft Corporation. They are the first batch out of 48 blimps authorised.

Duchess Inspects W.A.A.F.s

THE Duchess of Gloucester, who is an Air Commandant of the W.A.A.F., visited Fighter Command Headquarters, and was received by the Air Officer C.-in-C., Air Marshal W. Sholto Douglas, C.B., M.C., D.F.C. The Duchess, accompanied by the C.-in-C., inspected two duty watches of the W.A.A.F. Before having lunch in the W.A.A.F. Officers' Mess, she visited one of the W.A.A.F. hostels and saw the girls at lunch. Afterwards the C.-in-C. conducted the Duchess through the operations room.

Radio Mechanics

Young men now have a chance to learn the expert trade of Radio Mechanic—in the R.A.F. Formerly entry into this trade was reserved for skilled men; now a special course of training will be given to the right sort of candidate. The age limits are 18-30, and the standard for entry is fairly high. A school leaving certificate or its equivalent is desirable, and applicants must be physically fit, and mentally alert. It is a chance for the young man who is, perhaps, just below the standard for air crew duty.

Temporary Naval Commissions

A NUMBER of men with experience as civilian pilots are required for direct entry in commissioned rank. For men under 28 at least 100 hours' solo flying experience is necessary; otherwise they must enter as ratings and receive the full service training. A limited number of vacancies also exist for men over that age but under 45, who have 50 hours' solo to their credit. These latter are required for employment in training squadrons. Application should be made to the Secretary of the Admiralty (C.W. Branch), Whitehall, S.W.1, giving age, experience and other qualifications.

Field Award for Pilot

PILOT Officer H. M. Stephen, D.F.C. and Bar, No. 74 Squadron, has received the D.S.O. as a field award on the immediate recommendation to the King of Air Marshal W. Sholto Douglas, A.O.C.-in-C., Fighter Command. This is the first D.S.O. to be awarded in the field to a member of the British Home Defence Forces.

Pilot Officer Stephen has fought with skill and success in practically every stage of the air war. He flew again and again to the Dunkirk beaches during the withdrawal of the B.E.F. and he has been repeatedly in action during the battle of Britain. He has destroyed more than 20 enemy aircraft, including five in one day.

Together with his Flight Commander, who also had already been awarded the D.F.C., he lately shared the honour of shooting down the 600th enemy aircraft to be destroyed by fighters operating from a single R.A.F. station.

The Faithful Friend

The badge of No. 224 General Reconnaissance Squadron has a curious history. It shows a castellated tower with a serpent twining itself round the walls. Students of heraldry may recognise this as the arms of Otranto in Italy. The Squadron was originally formed at Otranto during the last war as No 6 Wing R.N.A.S., and was renumbered 66 Wing R.A.F. in April, 1918. It later became No. 224 Squadron. It was engaged in bombing Cattaro and Durazzo, and was disbanded in May, 1919. When the Squadron was re-formed in February, 1937, it was suggested that the arms of Otranto, the Squadron's birthplace, should be adopted as its badge.

The Italian Embassy in London supplied details of the design, and when this had been adapted to the needs of the R.A.F. it was shown as a matter of courtesy to the Embassy. When it was returned to the Squadron the copy of the badge bore the following signature: "Mussolini, Roma, 1938." The Embassy had sent it out to Italy for august inspection. Perhaps the Duce was intrigued by the motto at the base of the design, "Fedele all' Amico," "Faithful to a Friend."

The "Faithful Friend" in the design of the badge is the serpent itself. According to legend a princess imprisoned in a castle at Otranto was watched over and fed by a serpent until rescued by a local St. George.

Though faithfulness to friendship is not so characteristic, nowadays, of Italian serpents and others, St. George is still busy over the Straits of Otranto.

TOO HIGH, TOO HIGH: Practising deck landings with a Fairey Fulmar on one of the Fleet Air Arm's land ships. If the Fulmar had been at the right height the discs would have been held in the horizontal position.

Polish Pilots Decorated

FOUR pilots of the Polish Fighter Squadron of the R.A.F. were to-day decorated with the D.F.C. by the Air Officer Commanding-in-Chief Fighter Command, Air Marshal W. Sholto Douglas, C.B., M.C., D.F.C., at an aerodrome in the north of England. A fifth D.F.C. was awarded posthumously to a pilot who has been killed in action. Altogether these five pilots have destroyed forty-four German aircraft and severely damaged others.

This is the first occasion on which a Polish Squadron has received British decorations for gallantry. The pilots have also been awarded the Virtuti Militari, the highest Polish award for valour; so have Squadron Leader R. G. Kellett, D.S.O., D.F.C., the British C.O. of the Squadron, and former Flight Commanders, Squadron Leader J. A. Kent, D.F.C., A.F.C. and Squadron Leader A. S. Forbes, D.F.C.

The Squadron—No. 303—was formed at an R.A.F. Fighter Station on August 1st. Within a month it had become operational, and at once took part in the defence of London. During September the Squadron shot down more than one hundred German aircraft. Two of its best days were September 7th and 11th. On each day fourteen German aircraft were destroyed.

The Squadron traces its history back to 1919, when it was formed to help Poland in the war against Russia. At the end of the war the Squadron returned to Warsaw. It took part in the defence of Warsaw in September, 1939, and on the overrunning of Poland the pilots left the country, eventually reaching France via Roumania, Italy, Greece, and North Africa. In France the Squadron became dispersed, and fought in various sections of the Armée de l'Air. The pilots reached England in June.

LIGHTNING CONDUCTOR: Air Vice Marshal Keith Rodney Park, who has commanded the R.A.F. Fighter Stations defending London and the South-East during the Blitzkreig. He has been appointed a Companion of the Bath.

W.A.A.F. Recruits Wanted

THE demand for more and more training and operational units of the R.A.F. opens up vacancies for a large number of W.A.A.F. recruits. Age limits are from 18 to 43 and, if necessary, the selected occupation will be taught. Clerks, cooks, telephonists, wireless operators and sick bay attendants are all wanted.

The work of the radio operators is specially interesting. For this post younger women (up to 35) only are wanted. A high degree of intelligence is required and, what is very essential, the capacity to keep cool and a clear head under any conditions.

Award of Commendations

THE London Gazette of December 3, 1940, announced the award of commendations to Mr. Norman Stanley Hook and Mr. Charles Turnbull for gallant service in connection with the Royal Air Force.

Mr. Hook, who is employed as a civilian messenger on an R.A.F. station in S.E. England, distinguished himself during an enemy air attack on the station by his gallant conduct and disregard for his personal safety. His coolness and courage were a fine example to all about him. Mr. Turnbull, who is employed in a factory at Guardbridge, Fife, rendered conspicuous service in a gallant attempt to rescue the occupants of an aircraft which crashed in a river near his place of employment.

Czecho-Slovak Decorations

DR. BENES, President of the Czecho-Slovak Republic, visited an R.A.F. station in England and decorated Czech and British members of a Czecho-Slovak fighter squadron which had already brought down 36 enemy aircraft in combats over this country.

Dr. Benes, who was accompanied by General Mizbersky, head of the Czecho-Slovak Military Cabinet, General Ingr. Czecho-Slovak Minister of National Defence, and Air-General Jamouscak, Inspector of the Czecho-Slovak Air Force, first inspected contingents of Czecho-Slovak and British fighter squadrons and of the Women's Auxiliary Air Force. He then pinned the Czecho-Slovak Military Cross on the tunics of the airmen.

Four of the recipients were British: Wing-Commander A. B. Woodhall, Squadron-Leader D.

THEY WILL SOON KNOW BETTER: New Zealand pilot trainees of the Fleet Air Arm being told why a northerly compass bearing is difficult for beginners. This is no good reason why they should turn their backs on *Flight*.

Blackwood (English Squadron Leader of the Czecho-Slovak Squadron) and Flight-Lieutenants J. Jefferies, D.S.C., and G. L. Sinclair.

Later, the Czecho-Slovak and British airmen marched past the President, who took the salute. The Czecho-Slovak squadron was led by Major "X," who holds the British D.F.C. A number of the Czecho-Slovak airmen in the squadron, which has fought with great gallantry in the defence of Britain, now wear the decorations of three nations—the Czecho-Slovak Military Cross, the British D.F.C., and the French Legion d'Honneur and Croix de Guerre.

Awards

THE King has been graciously pleased to approve the undermentioned awards in recognition of gallant conduct:—

MILITARY CROSS.

P/O. (now F/O.) D. A. R. ELLIOTT.—One morning in August, 1940, this officer was on duty as navigation officer in the operations room of an aerodrome during an intense enemy bombing raid. The roof of this building was demolished, and a number of casualties occurred. P/O. Elliott, though slightly wounded and badly shaken, went to the assistance of the wounded, removing the rubble with his hands and directing the rescue party. Being the only officer left of the operations room staff, he organised a party to recover as many maps and documents as possible, and set up a skeleton organisation in the signals office. Going without food or rest, he acted as controller until late at night, when he was relieved. He showed great initiative and an exemplary sense of discipline and leadership.

MILITARY MEDAL.

CPL. B. JACKMAN.—When a severe bombing attack developed at an aerodrome, Cpl. Jackman ran to a gun post which he knew was manned by a less experienced crew. He retained one airman, and ordered the others to take cover. He then operated the twin Lewis guns with great courage and determination until the gun post was demolished and he was severely wounded. Cpl. Jackman's magnificent courage in the face of extreme danger merits the highest praise.

A/C.1 F. WILSON.—Aircraftman Wilson was a member of the crew of a high-speed launch which rescued some fourteen injured men from three ships of a convoy which were burning furiously. Later, when attempting the rescue of personnel from two planes which had fallen into the sea, the launch was attacked by nine enemy single-engine biplanes. The enemy raked the launch with machine gun fire and three fires were started by incendiary bullets. The wireless operator was killed, the man at the wheel had two bullets through his clothing and the master was knocked unconscious. A/C. Wilson seized the wheel and kept control of the launch in the heat of the action until the master returned. During the action a line fell overboard and fouled the propellers. As they could not be cleared, A/C. Wilson, in spite of the rough sea, went over the side with a bowline and endeavoured to clear them. This Aircraftman behaved in a most praiseworthy manner under the most difficult conditions.

A/C.2 A. D. ROWE.—During a dive-bombing attack on a station this airman manned one of two Hispano cannons with great skill and coolness, and thus shared in the destruction of at least two enemy aircraft. He remained at his self-appointed post during the whole of the action, without any cover and undeterred by bombs which were exploding some thirty yards away. He was deliberately machine-gunned from the air, but continued to handle his gun until the raid was over. A/C. Rowe showed courage, initiative and skill of a very high order.

CPL. J. M. G. ROBINS, WOMEN'S AUXILIARY AIR FORCE.—Cpl. Robins was in a dug-out which received a direct hit during an intense enemy bombing raid. A number of men were killed and two seriously injured. Though dust and fumes filled the shelter, Cpl. Robins immediately went to the assistance of the wounded and rendered first aid. While they were being removed from the demolished dug-out she fetched a stretcher and stayed with the wounded until they were evacuated. She displayed courage and coolness of a very high order in a position of extreme danger.

The King has been graciously pleased to approve the following awards to R.A.F. personnel for war services:—

GEORGE CROSS.

ACT. SQN. LDR. E. L. MOXEY, R.A.F.V.R. (DECEASED).—During August, 1940, it was reported that two unexploded bombs were embedded in an aerodrome. Sqn. Ldr. E. L. Moxey, a technical intelligence officer employed at the Air Ministry, immediately volunteered to proceed to the site and remove them, though from the nature of his duties he was very fully aware of the risk entailed in such an operation. One of the bombs exploded, causing his death. On many occasions Sqn. Ldr. Moxey had exhibited similar complete disregard of his personal safety.

O.B.E.

FLT. SGT. C. H. I. WOOD.
L.A/C. R. A. SUMMERS.

Early in September, 1940, a Blenheim aircraft, returning from a night operation, crashed and burst into flames in a field about 200 yards from where Flt. Sgt. Wood and L.A/C. Summers were working. These two airmen immediately ran to the scene of the crash and saw that the pilot was lying unconscious under the tail of the burning aircraft.

A first attempt to extricate him had to be abandoned owing to the sudden explosion of ammunition in the aircraft, but Flt. Sgt. Wood and L.A/C. Summers made a second attempt, and this time succeeded in dragging the pilot clear of the wreckage. Unfortunately their gallant efforts were unavailing, as the pilot subsequently died in hospital from head injuries received in the crash.

SERVICE AVIATION (CONTINUED)

Prisoners of War

NEXT of kin, if able to identify the men from the information published, are requested to advise the Casualty Branches of the Services concerned, forwarding Regimental or any other details.

The following is the latest list of British prisoners of war as received from enemy sources:—

Flt. Lt. F. H. Vivian, Grayshott, Hindhead, Surrey (and the entire crew of Flt. Lt. Vivian's plane); Sgt. A. R. Weston, Belgrave Square, Nottingham; Sgt. E. Wilson, 1, Ethelbert Close, Bromley, Kent; P/O. B. V. Urwick (?Curwen), Ipswich, Queensland, Australia; P/O. J. R. Denny, Sathchatty (?), Abbotsley, St. Neots, Hunts; P/O. G. C. Brown, Merronhill Park, Belfast; Sgt. J. E. Everson, Lewis Street, Matchon (?), Monmouthshire; Sgt. J. W. Massey, Park Road, Aberdeen; Sgt. T. Pickering, Crescent Road, Middlesborough; P/O. E. J. Clelland, Thorn (?) Road, Worthing, Sussex; Sgt. M. J. Cowley, Council Terrace, Eastington, Glos.; Sgt. E. Betterson (?) Torpy, Beaver Street, Hull; Sgt. D. C. Dumphie (?), Larkhill, Conway, North Wales; Sgt. F. Phillips, Berkeley Road, Warley, Birmingham.

Sgt. R. Nee, Lambsfold, Osset, Yorks; Sgt. D. H. Dunk, Hotel Empress, Bournemouth; Sgt. J. W. Mutch (or Light), Turnet Street, Redcar, Yorks; Sqn. Ldr. C. D. Swain (or Wayne), address unknown; Sgt. W. J. P. Shephard, Overland Road, Cottingham, E. Yorks; Sgt. W. H. M. Butcher, Bickley, Kent; Sgt. J. Ferguson, Walter Street, Glasgow; Sgt. R. E. Bush, Camden Road, London; Sgt. J. Gage, Four Acres, London Road, Salisbury.

The following corrected names and addresses of British prisoners of war in enemy hands have been received from a German source:—

Sgt. C. P. Fellowes (previously reported as Followes), Grimstead Lane, Lancing, Sussex; Sgt. J. F. Moyle (previously reported as J. F. Moir), Stourbridge, Sturminster Newton, Dorset (previously reported as Stalbridge); Sgt. D. Cain, Stoneykirk, Stranraer, Scotland (previously reported as of Milmayne, Estoneykirk).

REALISM: Sub. Lts. (A) of the R.N.V.R. learn the ins and outs of the Browning gun; or may easily do so since live rounds are apparently being used for instruction.

1670
XXVIII

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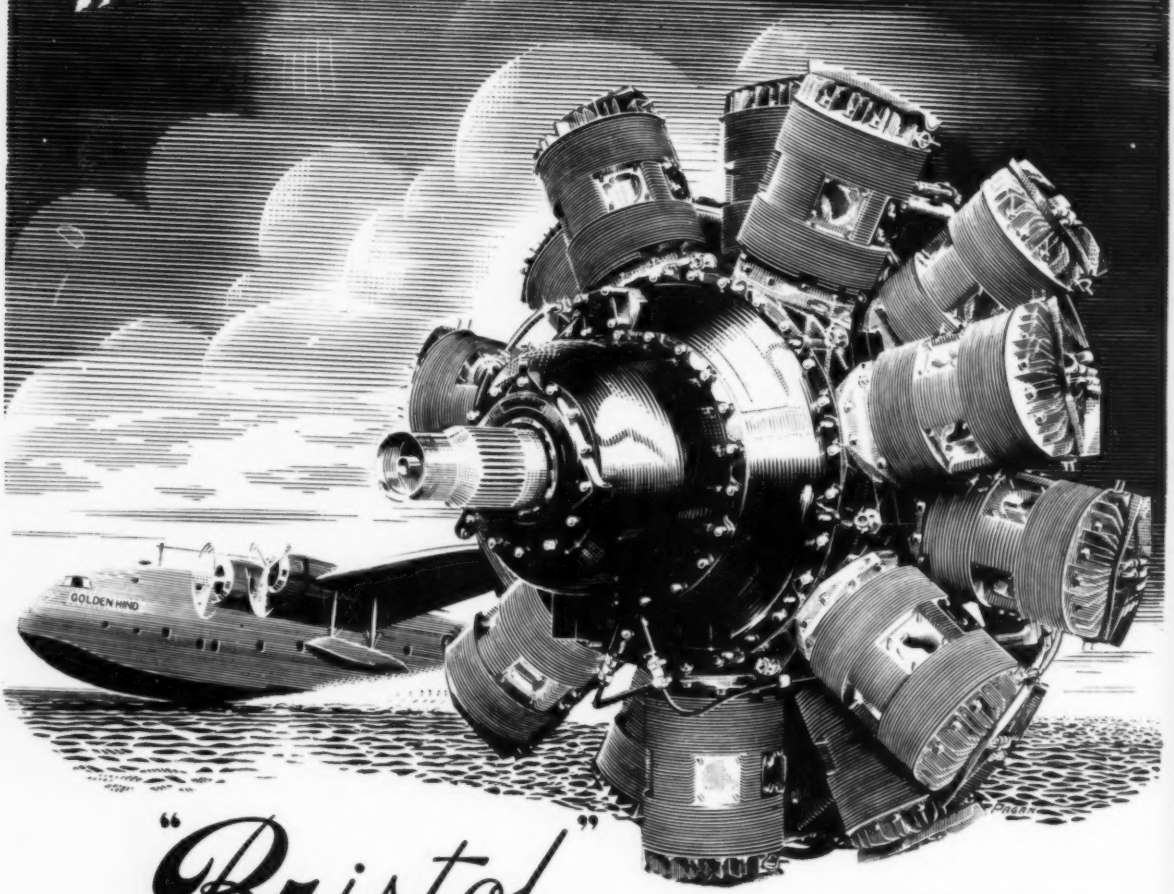

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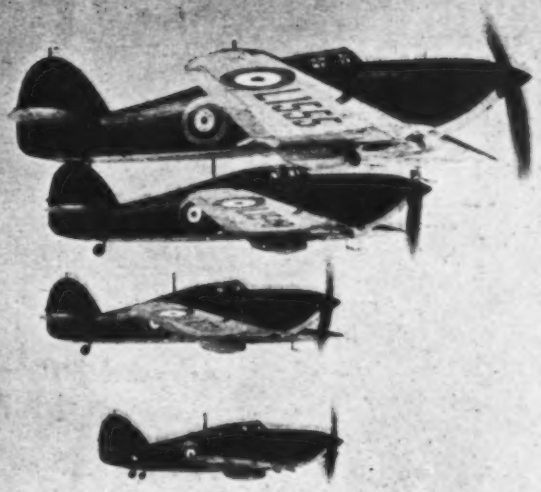

"Flight" photograph.

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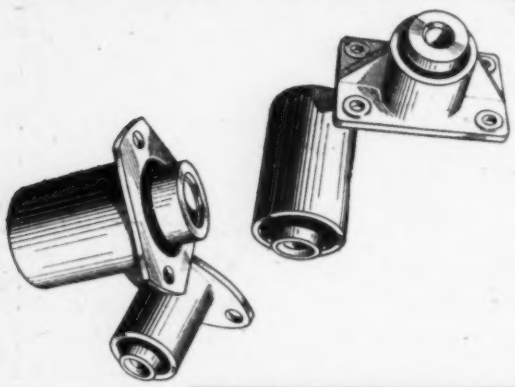

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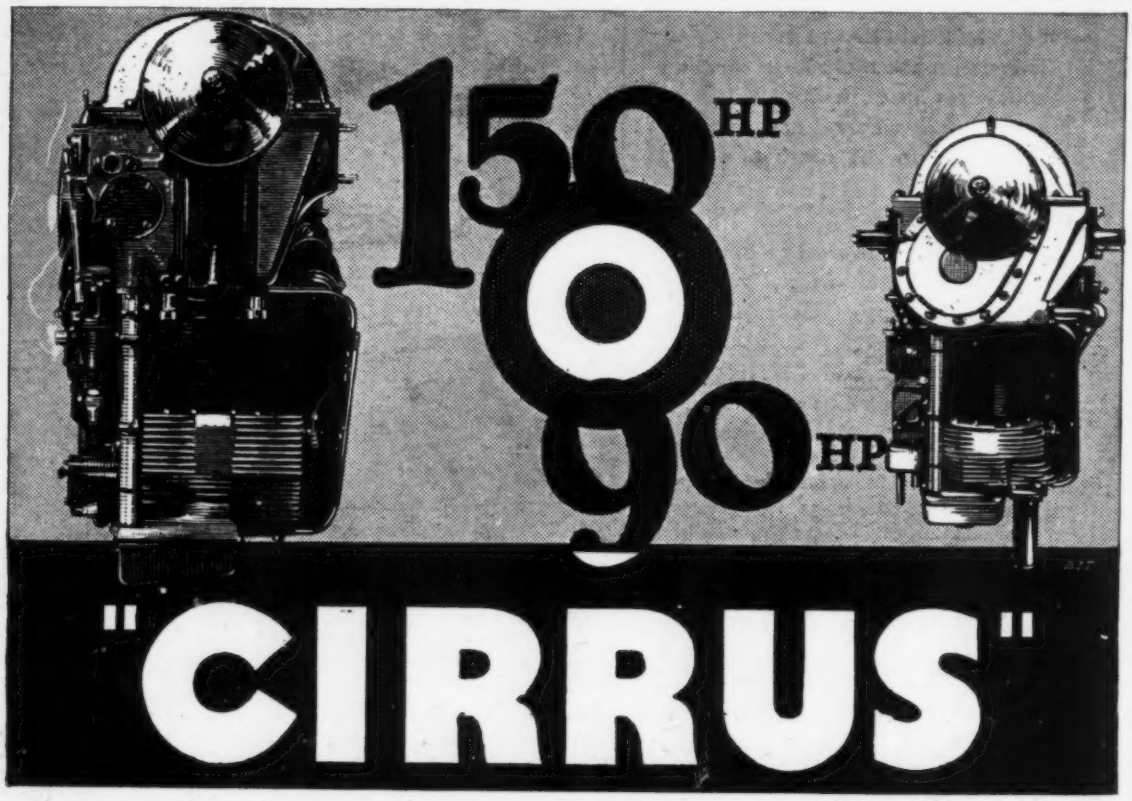

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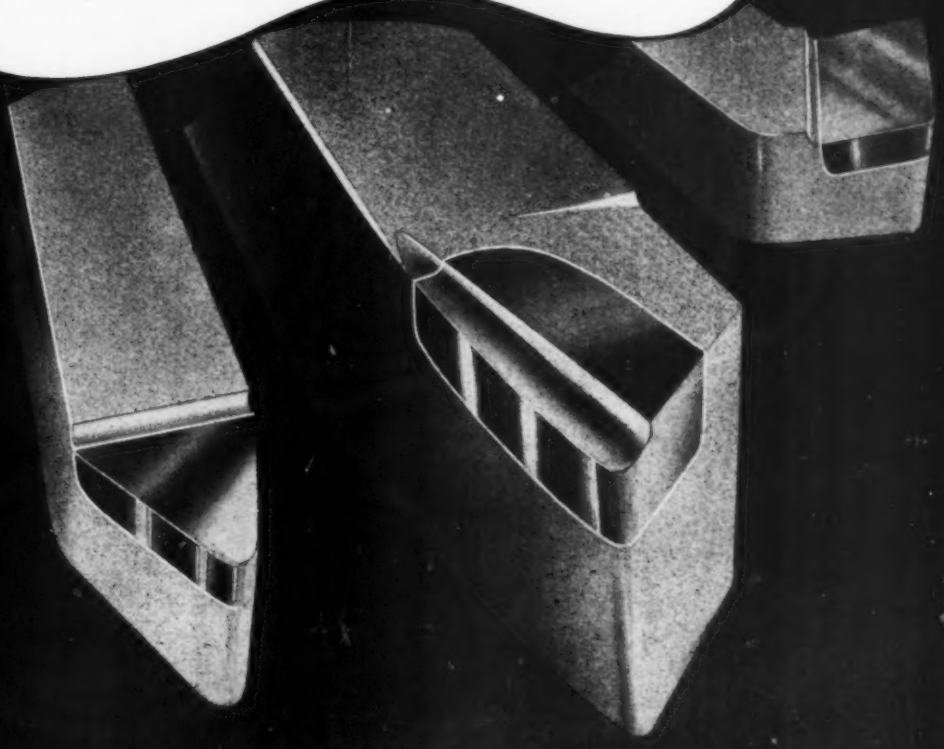

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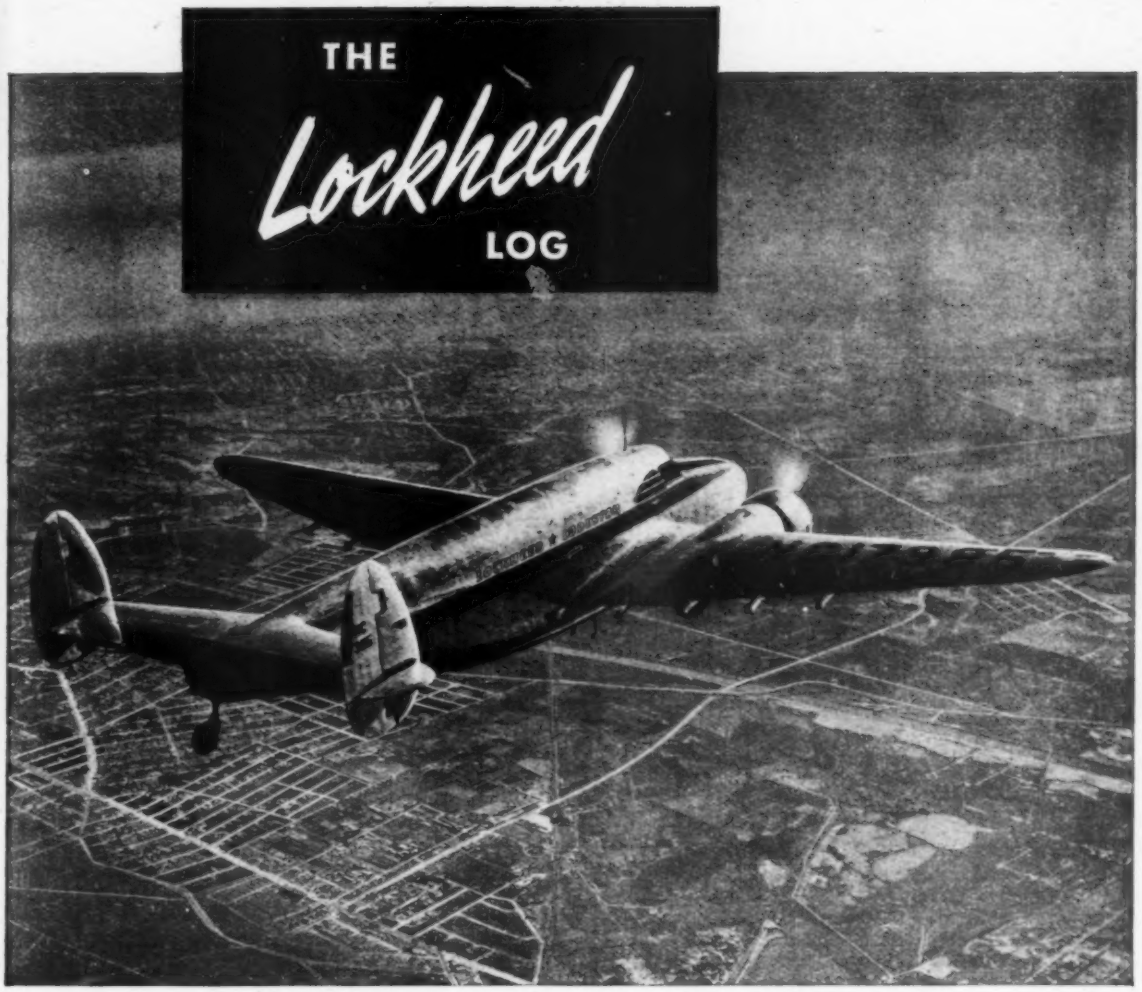

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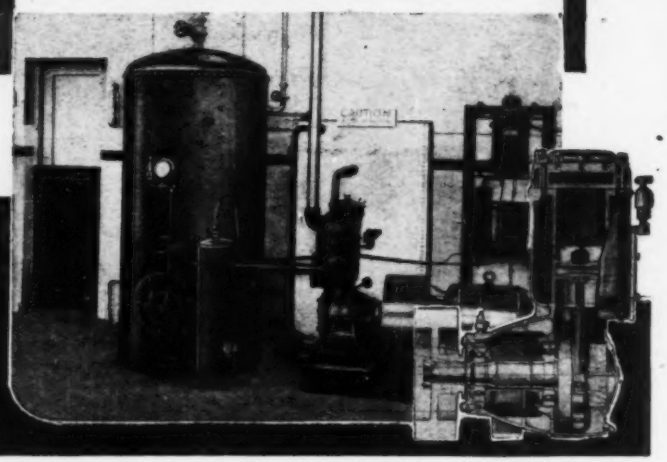

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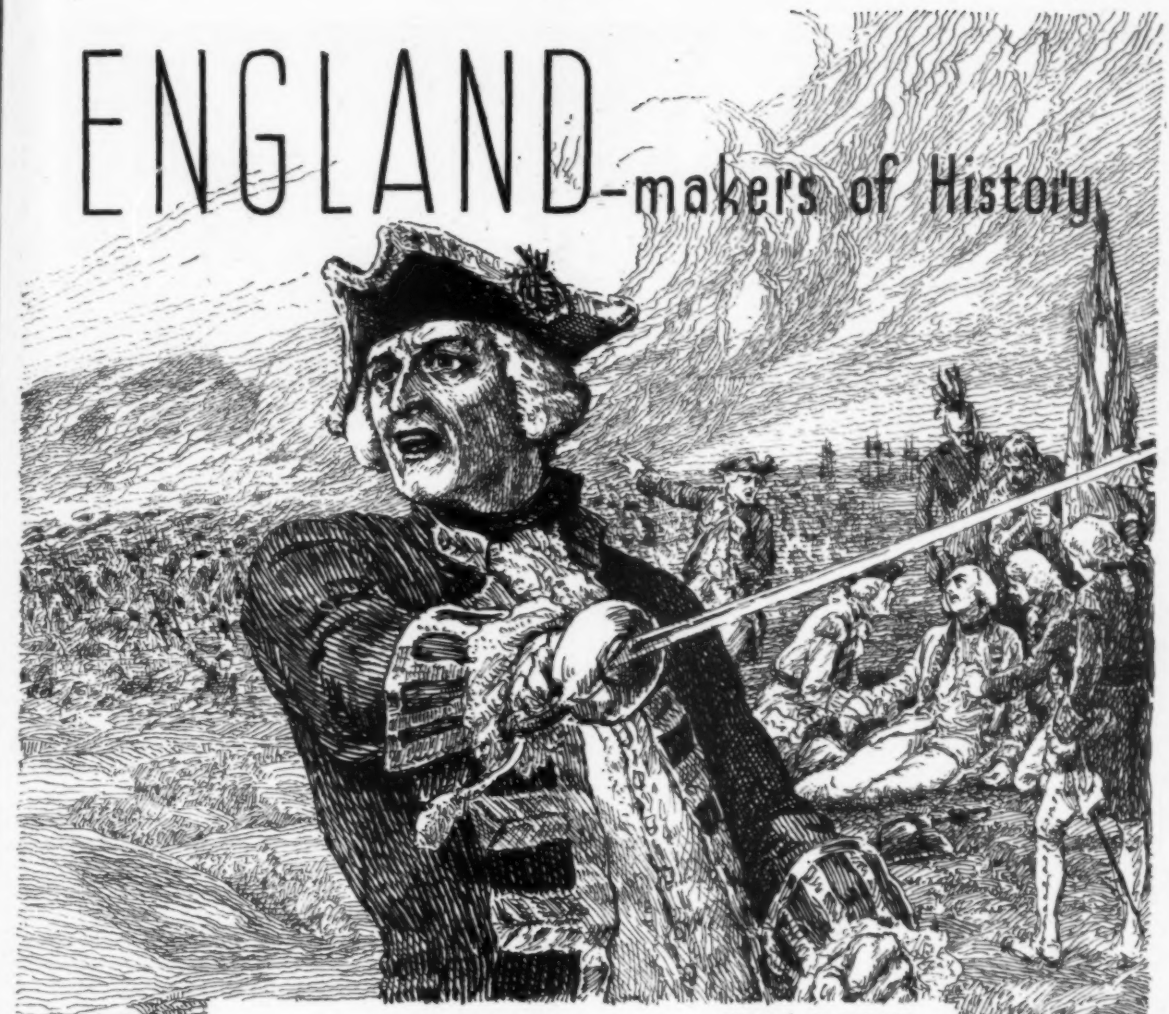

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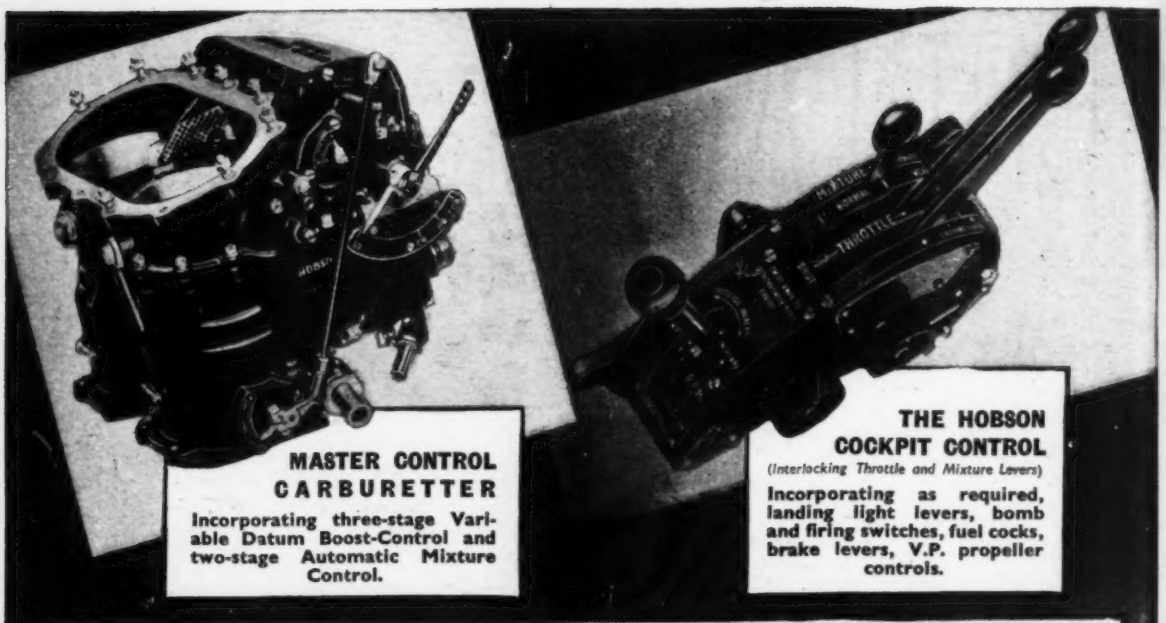

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I will have the mastery
In landes where we go."
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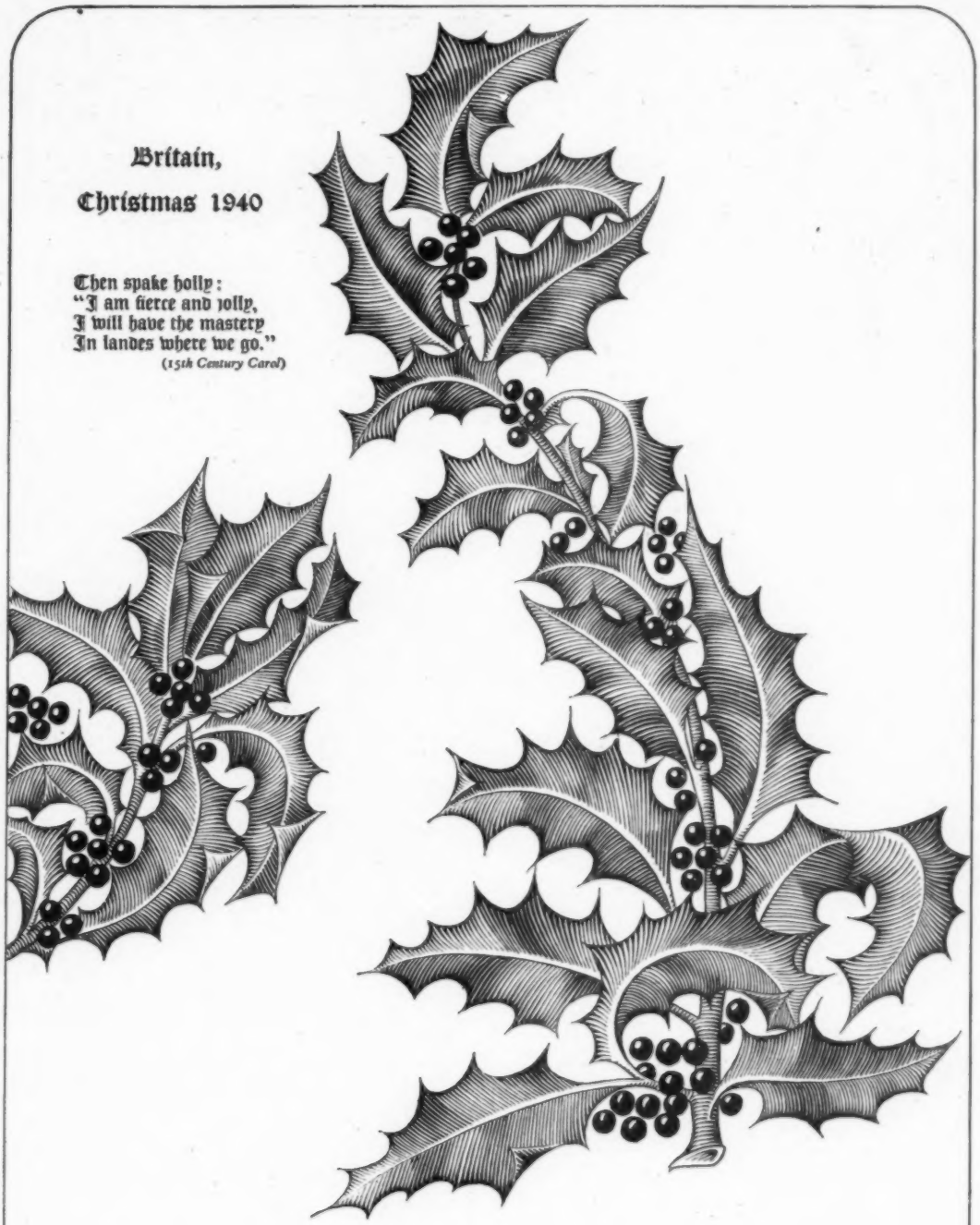

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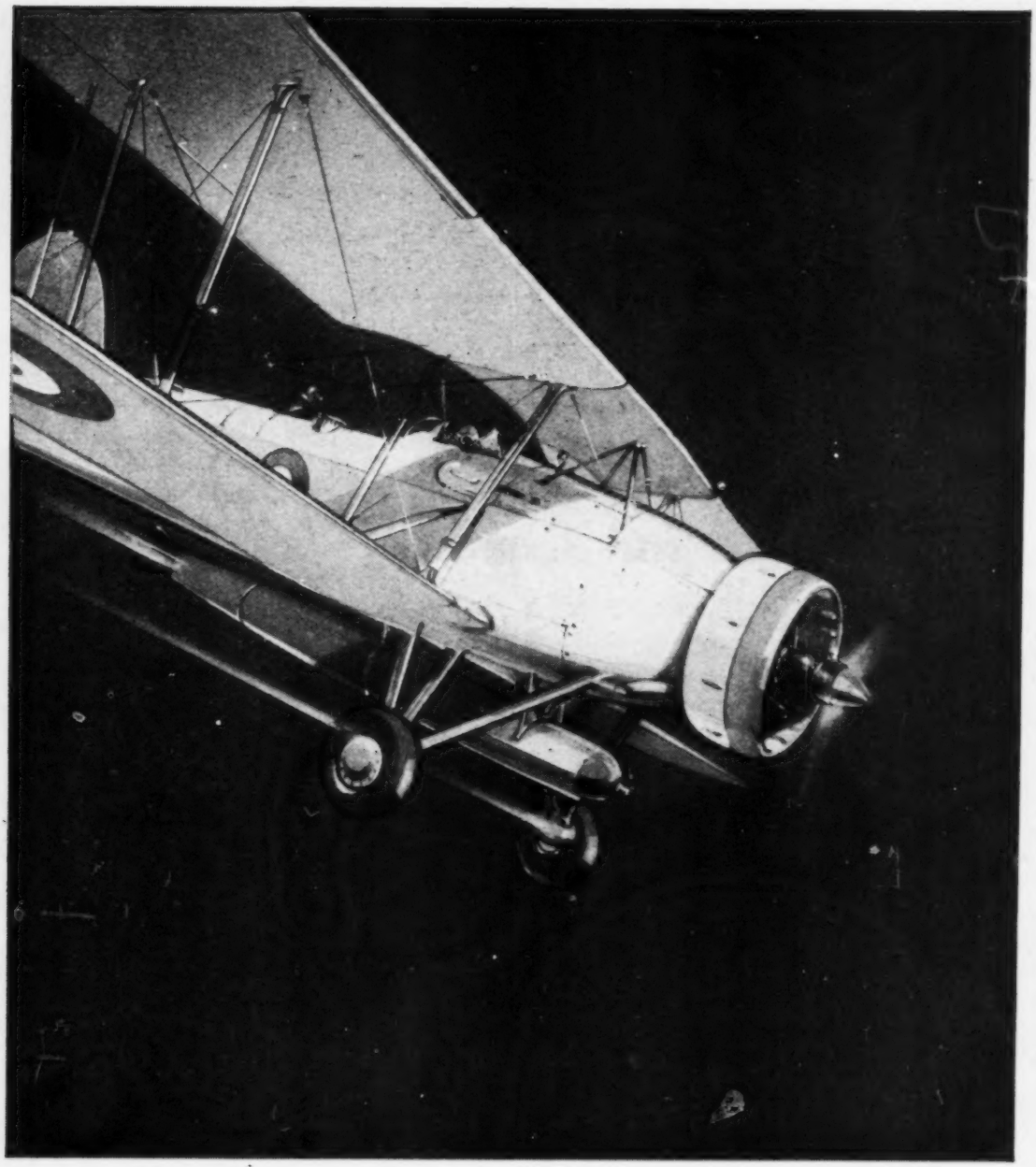

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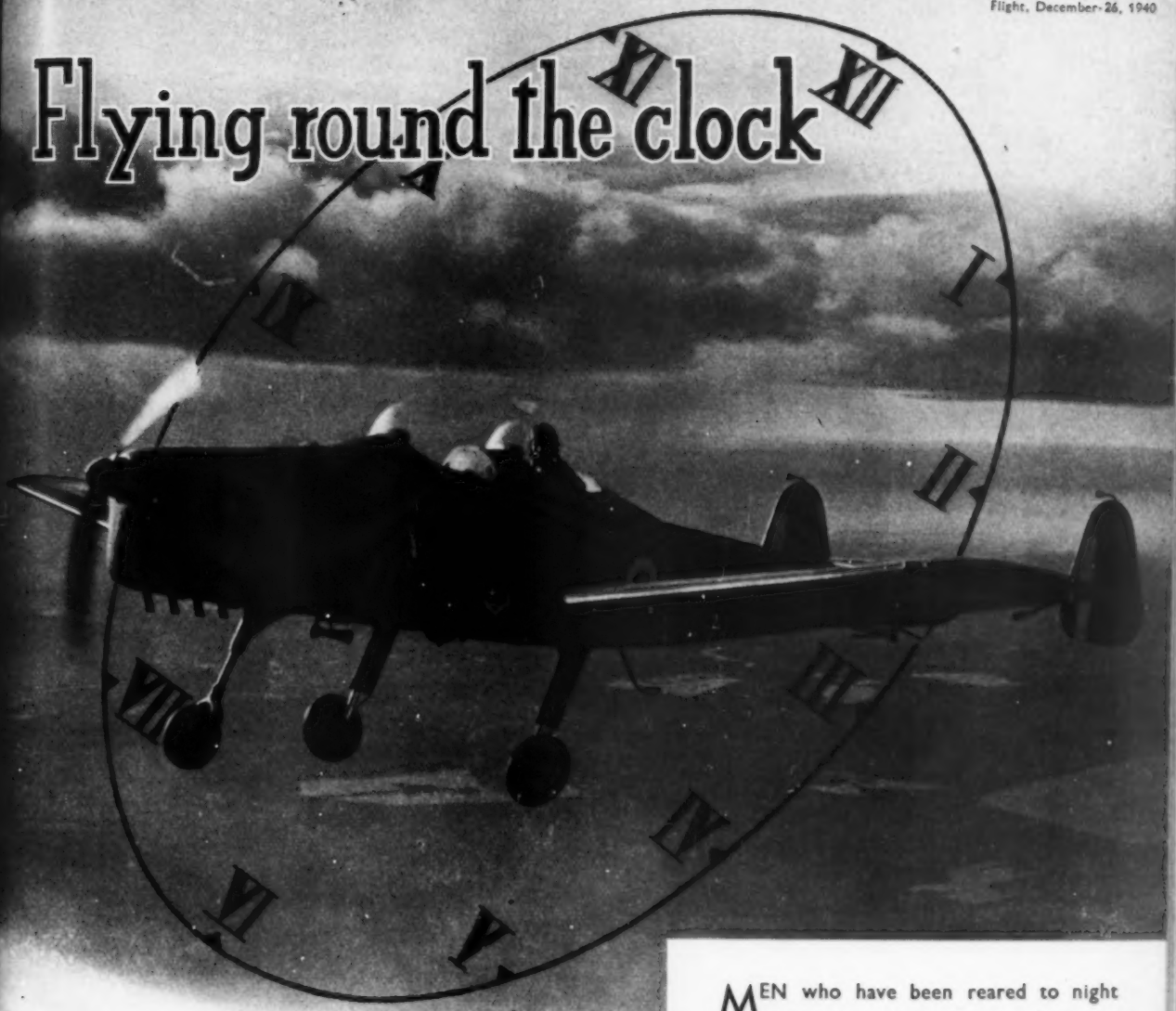

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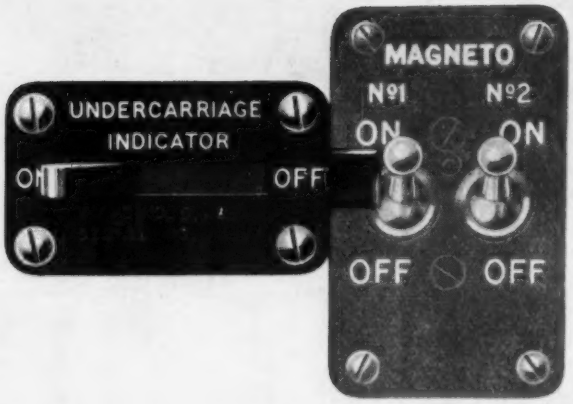

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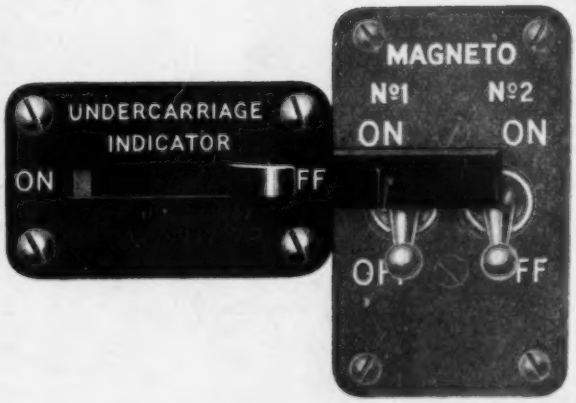

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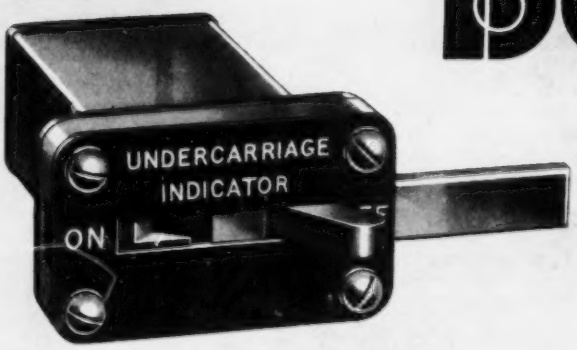

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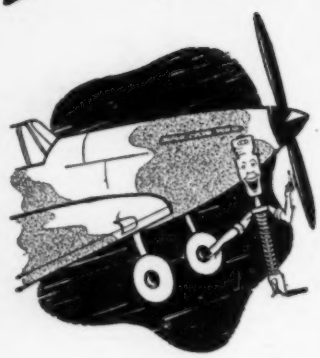

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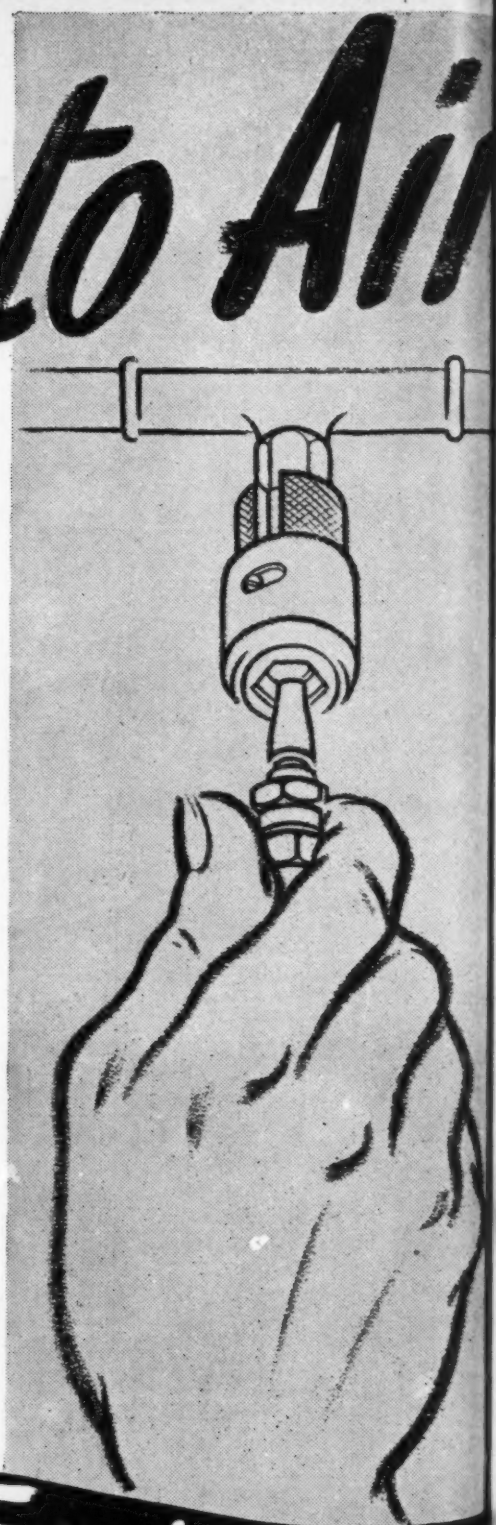

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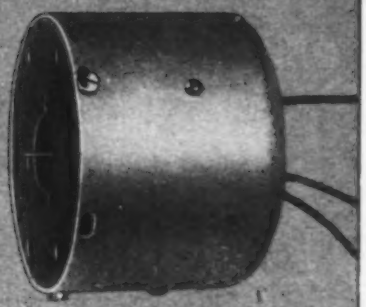

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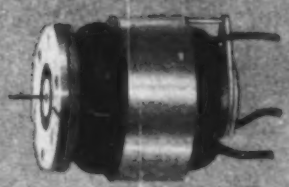

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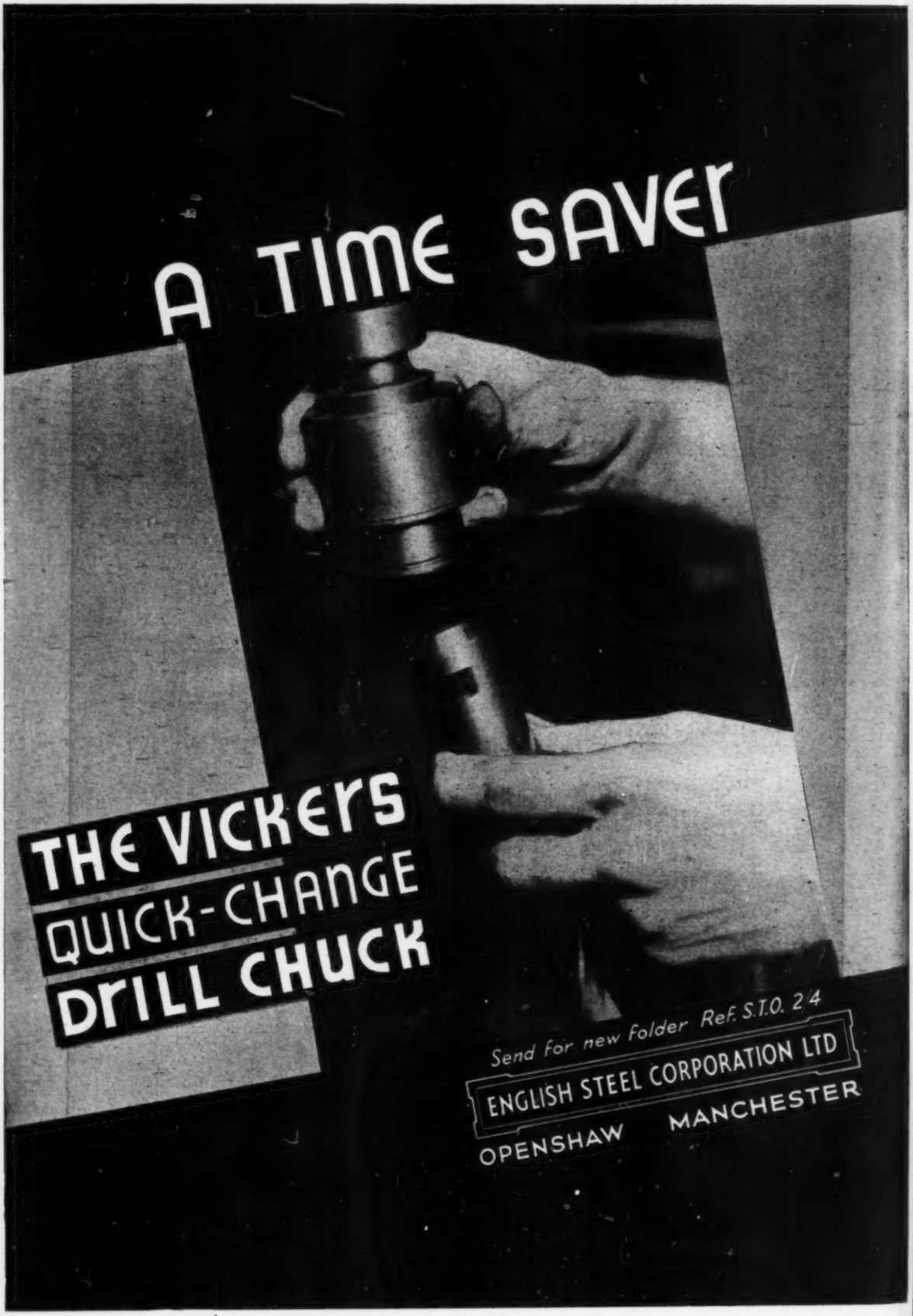
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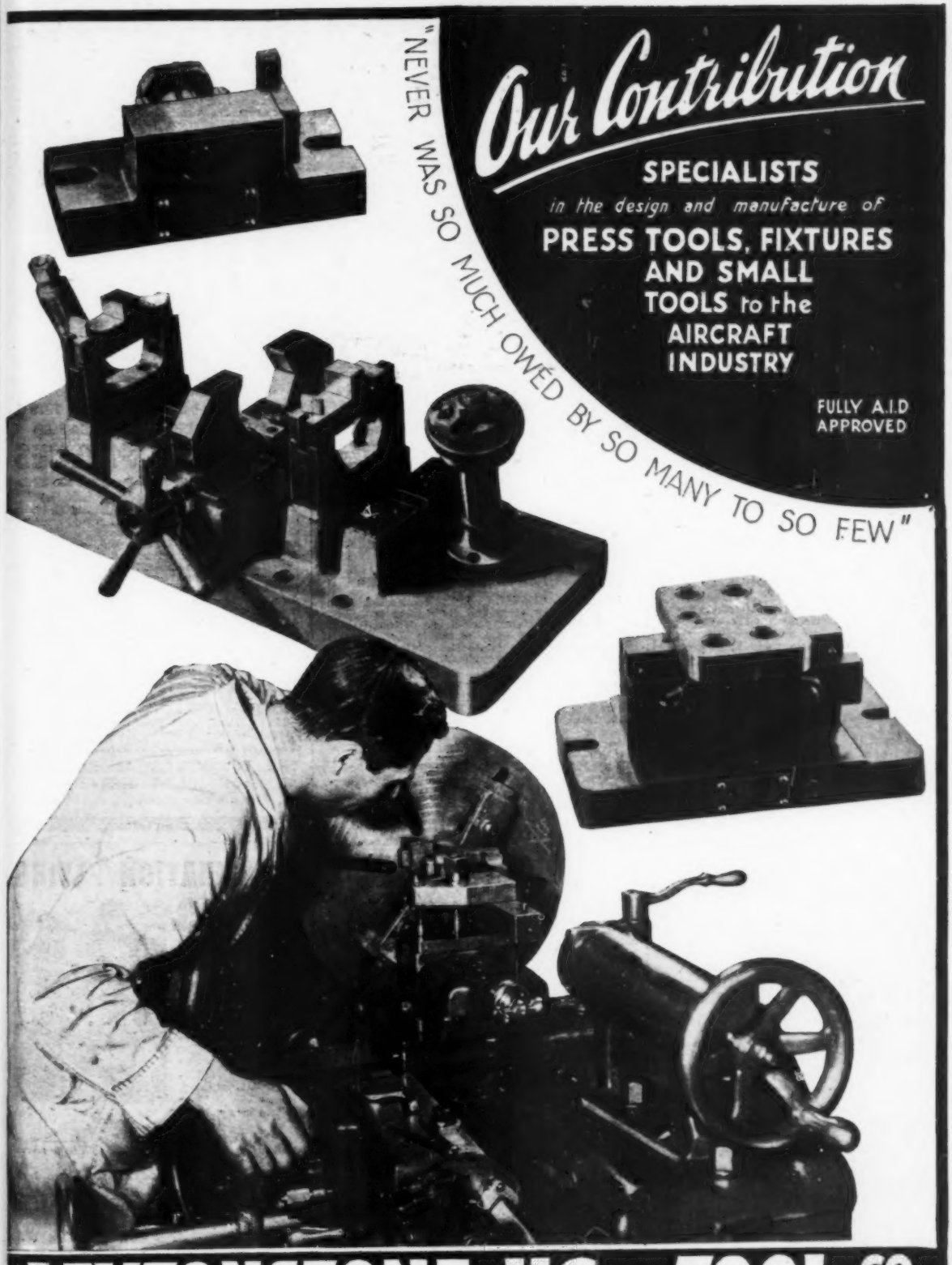
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THE Sergeants' Mess, R.A.F. Station, Cottesmore, send their best wishes for Christmas and the New Year to all Sergeants' Messes at home and abroad of the R.A.F., Fleet Air Arm and Dominion Air Forces. [3610

THE Engagement is Announced Between Pilot Officer Patric Rhodes Godby, R.A.F., younger son of Mr. and Mrs. M. H. Godby, of Christchurch, New Zealand, and Honor Mary, eldest daughter of Colonel H. W. H. Tyler, M.C., D.L., and Mrs. Tyler, of Grey Roofs, Oadby, Leicester. [3608

STAFF and Members of Southern Aircraft send Greetings and Good Wishes to all Pilots, R.A.F. and Members of the Aircraft Industry, at home and overseas. We know you are all doing your utmost to bring back the jollier times of pre-war days in aviation, and you can count on us to do our part. [3615

SITUATIONS VACANT

Readers are advised that restrictions now in operation prevent the insertion of advertisements offering Situations in the Aircraft Industry, other than posts for Managers, certain grades of Clerks, and Salesmen.

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ASSISTANT Works Manager Required for Aircraft Factory in West of England; applicants must have sound knowledge of aircraft production from detail to complete machine and be tactful and well used to handling labour; good opportunity for right man.—Send full details of past experience, age and salary, to Box 4718, c/o *Flight*. [3607

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AIRCRAFT Works Manager, small company engaged on aircraft salvage in East Midlands, require capable man to take charge of salvage and reduction.—Write full particulars, experience, salary required, etc., to Box 4719, c/o *Flight*. [3609

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CHIEF Inspector Desires Change, A.I.D. procedure; 14 years' aircraft experience.—Box 4717, c/o *Flight*. [3606

FOREMAN or Superintendent aircraft assembly desires post, the North preferred; excellent references.—Box 4721, c/o *Flight*. [3613

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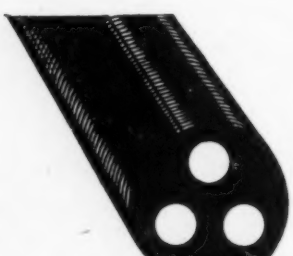

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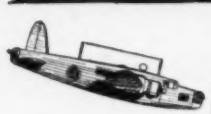

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